UNITED STATES DEPARTMENT OF LABOR
FRANCES PERKINS, Secretary
CHILDREN'S BUREAU . . KATHARINE F. LENROOT, Chief

Occupational Hazards to Young Workers

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REPORT NO. 5

WOODWORKING MACHINES

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OCCUPATIONAL HAZARDS TO YOUNG WORKERS

Report No. 1. The Explosives-Manufacturing Industries, Publication No. 273.
Report No. 2. Motor-Vehicle Drivers and Helpers, Publication No. 274.
Report No. 3. The Coal-Mining Industry, Publication No. 275.
Report No. 4. The Logging and Sawmilling Industries, Publication No. 276.
Report No. 5. Woodworking Machines, Publication No. 277.

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LETTER OF TRANSMITTAL

United States Department of Labor,
Children's Bureau,
Washington, November 1, 1941.

Madam: There is transmitted herewith a report on the occupational hazards to young workers of employment on woodworking machines. The report, one of a series of investigations made to guide the Chief of the Children's Bureau in determining occupations that are particularly hazardous for young workers and therefore subject to a minimum-age standard of 18 years under the Fair Labor Standards Act of 1938, was originally published in mimeographed form on May 2, 1941. It served as the factual basis for Hazardous-Occupations Order No. 5 issued June 24, 1941, and effective August 1, 1941, declaring certain occupations involved in the operation of power-driven woodworking machines to be particularly hazardous for workers 16 and 17 years of age. A copy of this order appears in the appendix to this report.

The Children's Bureau is grateful to the employers and workers in the wood-products industries and other industries in which woodworking machines are used, to the representatives of trade associations and unions, and to the officials of various State and Federal agencies, who made available the information on which this report is based.

The Bureau is especially indebted to the members of the Technical Advisory Committee on Hazards of Woodworking Machines, composed of representatives of employers and organized workers in the wood-products industries, safety engineers, and officials of State labor departments and industrial-accident commissions, who reviewed a preliminary draft of this report, made valuable suggestions on the basis of their knowledge of woodworking occupations and their hazards, and aided in the formulation of the proposed finding and order. The Technical Advisory Committee consisted of two sections, one of which met in Portland, Oregon, on February 5, 1941, and one in Washington, D. C., on February 18, 1941.

The following persons served on the committee and in a spirit of public service gave their time, experience, and judgment to a consideration of the hazards of employments in these occupations for young workers:

W. J. Baker, president, District Council No. 9, International Woodworkers of America, Olympia, Wash., representing the International Woodworkers of America.

O. Wm. Blaier, general representative, United Brotherhood of Carpenters and Joiners of America, Philadelphia, Pa.

R. P. Blake, senior safety engineer, Division of Labor Standards, United States Department of Labor, Washington, D. C., representing the International

Association of Industrial Accident Boards and Commissions and the American Standards Association Committee for the Safety Code for Woodworking Machinery.

J. F. Cambiano, United Brotherhood of Carpenters and Joiners of America, San Mateo, Calif.

R. H. Davis, manager, American Veneer Package Association, Washington, D. C.

W. A. Finnegan, Northeastern Box Co., Bangor, Maine, representing the National Wooden Box Association.

C. H. Fry, chief, Bureau of Industrial Accident Prevention, Industrial Accident Commission, California Department of Industrial Relations, San Francisco, Calif.

W. S. Gardner, assistant superintendent, United States Fidelity & Guaranty Co., Baltimore, Md., representing the National Conservation Bureau and the American Standards Association Committee for the Safety Code for Woodworking Machinery.

C. H. Gram, commissioner, Oregon Bureau of Labor, Salem, Oreg.

Irving E. Kesterson, Kesterson Lumber Corporation, Klamath Falls, Oreg., representing the Wooden Box Institute.

Henry P. Kobervig, superintendent of production, Wheeler Osgood Sales Corporation, Tacoma, Wash.

E. B. Miller, Red Lion Table Co., Red Lion, Pa., representing the National Association of Furniture Manufacturers.

H. R. Northup, secretary-manager, National Retail Lumber Dealers Association, Washington, D. C.

M. T. Owre, Western Pine Association, Portland, Oreg.

Max Perlow, United Furniture Workers of America, New York, N. Y.

Forrest H. Shuford, commissioner, North Carolina Department of Labor, Raleigh, N. C.

L. L. Tyler, safety engineer, Portland, Oreg., representing the Pacific Veneer Package Association.

The study was planned and carried on under the general direction of Beatrice McConnell, Director of the Industrial Division, Children's Bureau, and Elizabeth S. Johnson, Assistant Director in Charge of Research. The field work was conducted and the report written jointly by Sheldon W. Homan, safety engineer, and Saul Wallen, associate in hazardous-occupations research. The statistical material on industrial injuries was developed by Miriam Noll, specialist in accident statistics.

Respectfully submitted.

KATHARINE F. LENROOT, *Chief.*

HON. FRANCES PERKINS,
Secretary of Labor.

Occupational Hazards to Young Workers

Woodworking Machines

The extensive use of power-driven woodworking machines in industrial plants of many types, the ever-present danger of injury to workers engaged in occupations involved in the operation of these machines, and the fact that young persons under 18 years of age are frequently employed to perform such work indicated the necessity for an investigation to determine whether the minimum age for employment in operating or assisting in operating woodworking machines should be 18 years under the Fair Labor Standards Act of 1938. This investigation was made under the provisions of that act, which, while establishing 16 years as the minimum age for general employment, places on the Chief of the Children's Bureau the responsibility for determining occupations that are particularly hazardous for persons 16 and 17 years of age.[1] In such occupations it is provided that the minimum age for employment shall be 18 years.

The hazards of woodworking machines are widely recognized. Most of them have sharp working or cutting edges, operate at high speeds, and require that operators and off-bearers work in close proximity to the working parts. Contact with fast-moving cutting edges causes serious injuries, many of which result in permanently disabling amputations. High-speed saws sometimes cause "kickbacks" of lumber that imperil operators and off-bearers. Finally, the adjusting, setting up, and repairing of machines of this type involve further possibility of injury.

Years of promotion of safety principles and practices have resulted in the introduction and use of guards for many woodworking machines. However, because these devices are neither applicable to all types of work nor required on all types of machines, there has been no drastic curtailment of the great number of accidents caused by woodworking machines. Requirements for guarding, fixed by law or regulation, vary greatly from State to State.

There has been widespread recognition of the hazards of woodworking-machine employments for young workers. This recognition has taken the form of State laws setting a minimum age for employment on specified types of machines higher than the minimum age for general employment. But because the coverage of the laws is not uniform and because there is no legislation of this type in many States, substantial numbers of young workers continue to be employed as operators of or off-bearers from these extremely hazardous machines.

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[1] Appendix A, p. 43, presents the legal basis for the investigation.

Although the number of persons under 18 years of age employed in operating or assisting in operating power-driven woodworking machines is not known, available employment data, reports of field visits by Children's Bureau investigators, statements of representatives of employers and workers in the woodworking industries, and statistics on industrial injuries indicate that a considerable number of young workers are so employed and are being injured in such employments. For this reason, as well as for the reasons mentioned above, the hazards of occupations involved in the operation of power-driven woodworking machines were selected for intensive study. The purpose of the study was to determine the type and extent of the hazards confronting minors employed at these machines.

METHOD AND SCOPE OF STUDY

This report describes the hazards of occupations involved in the operation of power-driven woodworking machines, presents statistical data on the nature and extent of these hazards, summarizes the opinions of experts on the advisability of employing persons under 18 years for work on such machines, reviews the minimum-age standards for such employments maintained by employers and imposed by State laws, and assesses the value of mechanical guarding as a means of eliminating the hazards of power-driven woodworking machines.

Material on the nature and degree of the hazards of work on power-driven woodworking machines was obtained from visits to many types of plants utilizing such equipment. These plants, located in 10 States,[2] included sawmills, planing mills, veneer and plywood mills, box factories, chair factories, furniture factories, venetian-blind plants, battery-separator plants, basket factories, and woodworking shops of airplane factories. Full information on the hazards of the various types of machines was secured from managers, technicians, and safety engineers employed by these plants.

Opinions on the advisability of employing persons under 18 years of age in occupations involved in the operation of power-driven woodworking machines were obtained in interviews with employers, representatives of employer organizations and trade unions in the woodworking industries, officials of State labor departments and industrial-accident commissions, and safety engineers in the employ of private companies, insurance firms, and State and Federal agencies.

Provisions of various State laws restricting the employment of minors on woodworking machinery were reviewed; the N. R. A. codes for various industries in which woodworking machines are used extensively were studied; and the provisions with regard to the employment of young workers were noted.

Statistical data on industrial injuries were compiled from figures published by State agencies administering workmen's-compensation laws and from the annual industrial-injury surveys of the United States Bureau of Labor Statistics. These data include industrial-injury rates for industries in which power-driven woodworking machines are extensively used, data on the number and severity of injuries caused by woodworking machines as compared with other working machines, and data showing the relative severity of injuries inflicted by various types of power-driven woodworking machines.

No data are available to show the relation of the number of injuries caused by various types of woodworking machines to the number of man-hours of exposure to injury from particular types of machines. In their absence it has been necessary to rely more upon a knowledge of the characteristics of woodworking machines and of the nature of accidents caused by them than upon the statistical material available.

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[2] Alabama, Arkansas, California, Georgia, Louisiana, Mississippi, North Carolina, Oregon, South Carolina, and Washington.

The investigation covered all types of power-driven woodworking machines, regardless of the industry or type of factory in which such machines were used. The Children's Bureau has presented, in a separate report, the findings of an investigation of the hazards of logging and sawmilling employments for young workers.[3] That investigation dealt with hazards of all employments, both machine and nonmachine, in logging operations, sawmills, lath mills, shingle mills, and cooperage-stock mills. Because of the physical conditions under which the work is conducted, the nature of the materials handled, the characteristic plant lay-out, and the hazards of the machinery used, nearly all occupations in logging and sawmilling appear to be unsuited for the employment of workers under 18 years of age. Many occupations in those industries involve work in connection with power-driven woodworking machines. The present report, on the other hand, deals with the hazards of woodworking machines which are used in a great number of other industries, some engaged in fabricating wood products and others engaged in producing goods in which wood is only a minor part or used indirectly in the production of articles fabricated solely from other materials. The hazards of woodworking-machine employments in wood-products establishments have received chief attention in making this investigation; however, its findings are believed applicable regardless of the type of plant in which such machines are operated. The fact that this report is limited to consideration of the hazards of woodworking-machine employments does not imply that other employments in industries where these machines are used are necessarily free from hazards to minors. The hazards of these nonmachine occupations have not been included in the scope of this study.

Power-driven woodworking machines are generally understood to include all fixed or portable machines or tools driven by power and intended for cutting, shaping, forming, or surfacing wood or for nailing, stapling, wire-stitching, fastening, or otherwise assembling, pressing, or printing wood or veneer. In order to cut, shape, form, or surface wood, such tools must of necessity have sharp cutting edges or abrasive surfaces, and in order to work efficiently they must be operated at high speeds.

For convenience in discussing the hazards of woodworking machines and in compiling the statistical material used in the report, the hazards have been divided into several groups according to the method of performing work. The classification is as follows:

1. Saws.—Machines using a saw blade as the machine tool to cut entirely or partially through the thickness of wood stock.
2. Planers, shapers, jointers, molders, and other surfacing machines, including tenoners.—Machines which change the shape of or surface the stock by means of the planing action of a revolving cutting tool.
3. Lathes.—Machines which shape wood stock by revolving it against a stationary or rotary cutting edge.
4. Drilling and boring machines, including mortisers.—Machines which bore holes in wood stock by means of a revolving bit or drill or by means of a cutting chain.

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[3] Occupational Hazards to Young Workers, Report No. 4: The Logging and Sawmilling Industries. Children's Bureau Publication No. 276. Washington, 1942.

5. Sanding machines.—Machines using an abrasive for imparting a smooth surface.
6. Nailing machines.—Machines which nail, tack, staple, or wire-stitch wood or veneer.
7. Presses.—Machines which squeeze together stock for the purpose of forming joints, such as boxboard squeezers, or which provide the pressure needed to glue firmly together layers of wood or veneer, such as veneer presses or presses used for printing on wood or veneer.
8. Other woodworking machines such as barkers, rossers, and veneer clippers.

These types of machines present hazards both to operators and to those who help operators to feed material into them, as well as to workers engaged in setting up, cleaning, oiling, adjusting, or repairing them. Some of these types of machines present hazards also to workers engaged in off-bearing. The hazards of all these occupations involved in the operation of woodworking machines were the subject of study.

WOODWORKING MACHINES AS A SOURCE OF EMPLOYMENT AND AS A CAUSE OF INJURIES

Woodworking machines cut, shape, form, or surface wood for use as raw material or as a finished product. Since wood is utilized to a greater or lesser degree in the manufacture of a wide variety of products, power-driven woodworking machines are found in nearly every industry. Thus table saws, swinging cutoff saws, boring machines, drills, and other woodworking machines are found not only in such places as furniture factories, which are engaged chiefly in fashioning wood into finished articles, but also in such places as the pattern shop of an airplane factory in which the finished product may be constructed almost entirely of metal. Nailing machines are used not only in wooden-box factories but also in the shipping departments of canneries and many other types of factories to assemble boxes and crates. Drill presses are used in the woodworking shops of automobile plants as well as in chair factories. Wood lathes are used in planing mills, in machine shops, in broom and brush factories, and in many other types of establishments.

However, power-driven woodworking machines are found in the greatest number in the industries in which wood in some form is the principal material or product. The more important wood-products establishments, in addition to those with which the Bureau's report on the hazards of logging and sawmilling employments was concerned (that is, logging operations, sawmills, shingle mills, lath mills, and cooperage-stock mills), are furniture factories, planing mills, wooden-box factories, establishments engaged in producing turned and shaped wooden goods, factories making caskets, coffins, and burial cases, basket factories, plywood mills, and cooperage plants.

Extent of Employment on Woodworking Machines

Woodworking machines are one of the classes of machines most commonly used in industry. A large number of workers are engaged in occupations involved in their operation. No reliable figures or estimates either of the number of persons engaged in woodworking-machine occupations or of the number of woodworking machines in industrial use are known to exist. Neither the Census of Occupations nor the Census of Manufactures includes data which would provide the basis for such estimates. However, in 1937, according to the Census of Manufactures, the industries in which wooden articles are the principal products, exclusive of logging operations, sawmills, shingle mills, lath mills, and cooperage-stock mills, employed 339,833 workers in all occupations, both machine and nonmachine, in 9,015 establishments.[4] Independent planing mills and factories producing furniture, wooden boxes, coffins, and miscellaneous wooden goods employed the great majority of these workers (table 1). To this figure should be added an undetermined number of workers employed in planing mills and box factories operated in connection with sawmills but classified with sawmills by the Census of Manufactures.

TABLE 1.—*Number of wage earners in industries in which wooden articles are the principal products; United States, 1937* [1]

Industry	Number of wage earners	Number of establishments
All industries	339, 833	9, 015
Furniture, including store and office fixtures	170, 072	3, 097
Planing-mill products and other wooden products not elsewhere classified, made in planing mills not connected with sawmills	66, 814	2, 858
Boxes, wooden, except cigar boxes	25, 981	634
Wood turned and shaped and other wooden goods, not elsewhere classified	23, 087	755
Caskets, coffins, burial cases, and other morticians' goods	13, 678	521
Cooperage	9, 588	397
Baskets and rattan and willow ware, not including furniture	9, 308	194
Matches	5, 261	25
Cork products	3, 599	35
Mirror and picture frames	3, 382	163
Boxes, cigar, wooden and part wooden	3, 296	69
Window and door screens and weather strip	2, 833	144
Lasts and related products	1, 444	48
Excelsior	960	52
Billiard and pool tables, bowling alleys, and accessories	530	23

[1] Excludes logging camps; sawmills; planing mills and box factories operated in connection with sawmills; turpentine and rosin; synthetic-resin, cellulose-plastic, vulcanized-fiber, and molded and pressed pulp fabricated articles, not elsewhere classified; and wood preserving.

Compiled from the Biennial Census of Manufactures, 1937, pt. I—Group 3, Forest Products, pp. 457–458. U. S. Bureau of the Census, Washington, 1940.

Not all the wage earners in these industries worked at occupations involved in the operation of power-driven woodworking machines. However, many of them did work directly at such machines, although the proportion so employed is not known in the case of most of these industries. Calculations based on data contained in Wage and Hour Structure of the Furniture-Manufacturing Industry, October, 1937,[5] indicate that of 33,199 employees in the wood household-furniture branch, 8,292 (25 percent) were engaged in operating or assisting in operating power-driven woodworking machines. In planing mills, box factories, and wood-turning plants the proportion of workers so engaged is probably considerably higher since these industries do not have the many gluing, assembling, finishing, and inspecting jobs characteristic of the furniture industry.

On the other hand, there are many workers employed at woodworking machines in industries not classified as woodworking industries. The number of workers in other industries engaged in occupations concerned with the operation of power-driven woodworking machines is not known, but although the total is undoubtedly large, they probably constitute a small proportion of the workers in most of those industries.

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[4] The group of industries referred to as logging operations, sawmills, shingle mills, lath mills, and cooperage-stock mills is excluded because employment in such establishments is taken into account in the companion report on the hazards of logging and sawmilling employments for young workers. In 1937 there were 7,647 such establishments employing 323,928 wage earners. Of course, many sawmilling workers also are operators of or off-bearers from woodworking machines.

[5] Bulletin No. 669, table 43, pp. 72–73. Bureau of Labor Statistics, U. S. Department of Labor. Washington, 1940.

Employment of Minors in Woodworking-Machine Occupations [6]

As in the case of workers of all ages, there is no information available which shows how many persons under 18 years of age are engaged in occupations involved in the operation of woodworking machines. A rough indication of the extent of such employment can be secured by examination of figures on the number of workers under 18 years of age employed in industries using woodworking machines. Under the old-age and survivors insurance program some data are available on the number of workers under 18 years of age in the furniture industry and in other industries producing finished lumber products. These figures show for the last quarter of 1938 that there were 4,243 such persons, constituting 1.2 percent of the total number of workers of all ages in those industries. It is likely that many of them were engaged in various capacities in operating woodworking machines. There are indications, however, that this quarterly figure is an understatement of the actual extent of employment of youths in these industries: First, because of the existence of small, isolated, sometimes intermittently operated factories, it probably has not been possible to secure complete reporting of taxable wages; second, the data do not reflect employment of youths during the summer vacation, the time they are most likely to be employed in these industries.

The Census of Occupations for 1930 is another source of information from which some indication of the extent and geographical distribution of the employment of young persons on woodworking machines can be obtained through reference to industry figures. In that year there were 11,218 persons 10 to 17 years of age gainfully occupied as operatives or laborers in furniture factories, piano and organ factories, and other woodworking factories. They constituted 5.6 percent of the normal total of 200,269 persons of all ages gainfully occupied in these pursuits (table 2). It is likely that many of them were employed at or near woodworking machines. These young persons were employed in 34 States widely scattered geographically, although 80 percent of them were found in 17 States. Nearly a third of these 11,000 young workers were employed in the 4 States of North Carolina, New York, Pennsylvania, and Virginia (table 3).

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[6] Sawmills are excluded from the data presented in this section because employment in them was taken into account in discussing this problem in the report on the hazards of logging and sawmilling employments. Some of the sawmilling workers 10 to 17 years of age, who in 1930 numbered 15,736, were operators of or off-bearers from woodworking machines. Included with and not separable from the data given in the Census of Occupations on the number gainfully occupied in sawmills is the number gainfully occupied in independent planing mills and in wooden-box factories. Hence, the figures from the Census of Occupations cited in this section are an understatement of the number gainfully occupied in the wood-products industries.

TABLE 2.—*Percentage of operatives and laborers, 10 to 17 years of age, in woodworking factories; United States, 1930* [1]

Industry	Total	10 to 17 years of age	
		Number	Percent
Total	200, 269	11, 218	5. 6
Furniture factories	115, 037	5, 952	5. 2
Piano and organ factories	9, 841	232	2. 4
Other woodworking factories	75, 391	5, 034	6. 7

[1] Excludes sawmills and planing mills. Sawmills and planing mills operated in connection with sawmills are treated in the report on the hazards of logging and sawmilling employments for young workers Also excluded from this table are wooden-box factories, data for which are not separable from those for sawmills and planing mills.

Compiled from the Fifteenth Census of the United States, 1930, Population, vol. V, table 6, pp. 122, 126. U. S. Bureau of the Census, Washington, 1933.

TABLE 3.—*Minors, 10 to 17 years of age, gainfully occupied as operatives and laborers in woodworking industries in specified States, by age; United States, 1930* [1]

State	Minors 10 to 17 years of age					
	Total		10 to 15 years		16 and 17 years	
	Number	Percent	Number	Percent	Number	Percent
United States	[1] 11, 293	100. 0	1, 562	100. 0	9, 731	100. 0
North Carolina	1, 066	9. 4	221	14. 1	845	8. 7
New York	860	7. 6	83	5. 3	777	8. 0
Pennsylvania	844	7. 5	114	7. 3	730	7. 5
Virginia	789	7. 0	167	10. 7	622	6. 4
Illinois	732	6. 5	39	2. 5	693	7. 1
Michigan	667	5. 9	39	2. 5	628	6. 4
Indiana	630	5. 6	11	. 7	619	6. 4
Massachusetts	588	5. 2	95	6. 1	493	5. 1
New Jersey	400	3. 6	54	3. 5	346	3. 6
Ohio	370	3. 3	9	. 6	361	3. 7
Missouri	361	3. 2	67	4. 3	294	3. 0
Tennessee	343	3. 0	60	3. 8	283	2. 9
Georgia	307	2. 7	91	5. 8	216	2. 2
Arkansas	306	2. 7	66	4. 2	240	2. 5
Washington	293	2. 6	34	2. 2	259	2. 7
Maryland	235	2. 1	36	2. 3	199	2. 0
Wisconsin	229	2. 0	12	. 8	217	2. 2
Other States [2]	2, 273	20. 1	364	23. 3	1, 909	19. 6

[1] Excludes sawmills, planing mills, and wooden-box factories, wherever separable data are available. See table 2, footnote 1. The difference between the totals in this table and in table 2 is due to the fact that some of the State tables include sawmill and planing-mill operatives and laborers with workers in other woodworking factories.

[2] In each of these States there were either no operatives or laborers 10 to 17 years of age gainfully occupied in woodworking industries in 1930 or they formed less than 2.0 percent of the total number of such operatives and laborers in the United States.

Compiled from the Fifteenth Census of the United States, 1930, Population, vol. IV, table 23. U. S. Bureau of the Census, Washington.

Since 1930, several factors have tended to reduce the number of young persons employed in industry, and it is likely that they have influenced the course of employment of young workers on woodworking machines. The employment of young persons tends to rise and fall with that of adults. The depression years probably tended to force these young, marginal workers out of the labor market. The surplus of adult labor existing since then has in all likelihood further restricted their opportunity for reemployment. In addition, since 1930 a number of States have raised the legal minimum age for employment or for leaving school. Also, several States have statutes forbidding the employment of minors under 18 years in woodworking-machine occupations. It is likely, therefore, that there has been some decrease in the number of persons under 18 years gainfully occupied on woodworking machines since 1930.

It seems reasonable to regard the 4,243 workers for whom taxable wages were reported under the program for old-age and survivors insurance during the last quarter of 1938 as representing the minimum of present employment of workers under 18 years of age in wood-products factories. On the other hand, the 11,218 workers 10 to 17 years of age gainfully occupied as operatives and laborers in furniture and other woodworking factories in 1930 probably represent the upper limit of present employment of young workers. It is likely that the actual number employed at present is somewhere between these extremes.

It must be borne in mind that not all the young people employed in the wood-products industries are engaged in occupations involved in the operation of woodworking machines. On the other hand, there unquestionably are many workers under 18 years of age employed in woodworking-machine occupations in industries other than wood-products industries.

There is ample additional evidence of the employment of youths in woodworking-machine occupations at this time. In a number of States employment certificates have been issued to youths under 18 for such work. In the State of Washington alone 346 certificates were issued to minors under 18 years of age for work in the lumber industries during the period from January 1, 1938, to December 31, 1939. In Pennsylvania, of the injuries occurring to minors under 18 years of age from 1934–39, investigated for illegal employment, 126 occurred in industries classed as "lumber and its manufactures."[7] It may safely be assumed that one such injury indicates the employment of a number of young persons of these ages. The Children's Bureau has received numerous letters from both employers and prospective young employees asking whether it is contrary to the provisions of the Fair Labor Standards Act for persons 16 and 17 years of age to be hired in the woodworking industries. Inspectors of the Children's Bureau and of the Wage and Hour Division have filed reports of inspections showing that persons under 18 have been employed in woodworking occupations.

Woodworking-Machine Occupations Followed by Young Workers

Existing information on the specific jobs filled by young workers in woodworking plants shows that 16- and 17-year-old minors work at a variety of woodworking machines. In the State of Washington, employment certificates issued to minors under 18 for work in wood-

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[7] Child Workers in Pennsylvania, 1934–39, p. 8. Bureau of Women and Children, Pennsylvania Department of Labor and Industry. Harrisburg, 1940.

working plants included the following occupations: Tailer on ripsaw in a lumber mill; planer and Linderman-machine helper in a planing mill; off-bearer in a lumber mill; cutoff-saw tailer in a lumber mill; lathe operator in a chair factory; planer operator in a planing mill; sticker off-bearer in a door factory; dragsaw operator in a lumber mill; swinging cutoff-saw operator in a shingle mill; lath trimmer in a lath mill; clipper helper in a plywood mill; off-bearer in a box factory; stitching-machine operator in a box factory; stitching-machine tailer in a box factory; resaw tailer in a box factory; trim-saw tailer in a box factory; ripsaw tailer in a box factory; nailing-machine operator in a box factory.

Children's Bureau representatives inspecting sawmills, veneer mills, box factories, and basket factories in connection with the enforcement of the child-labor provisions of the Fair Labor Standards Act report instances of young workers under 16 and 18 years of age engaged in operating a variety of power-driven saws, nailers, and wire-stitching machines. During visits made to woodworking plants in the course of this investigation, workers apparently under 18 years were seen at work as off-bearers from table saws and from machines slicing wood blocks into battery separator stock, as feeders of stapling and wire-stitching machines used in making baskets, as operators of or off-bearers from veneer clippers, and as operators of or off-bearers from other woodworking machines.

The investigation showed that the practice of training apprentices in woodworking plants has not been widely adopted. No apprentices under 18 years of age were found, nor was any widespread interest in training apprentices manifested. Trades in the wood-products manufacturing industries in which apprentices were trained seemed to be limited largely to cabinet-making and millwork plants. These plants customarily employ as apprentices workers at least 18 years of age.

HAZARDS OF WOODWORKING MACHINES

Woodworking Machines as a Source of Industrial Injuries

Woodworking machines are an important source of industrial injuries. Because of their widespread use and their dangerous character, power-driven saws, lathes, sanders, and other woodworking machines are responsible for many thousands of injuries to workmen annually. Woodworking-machine injuries constitute a substantial proportion of the injuries caused by all working machines.

The number of injuries due to this source occurring in the Nation as a whole is not known. Some indication of the importance of woodworking machines as a source of industrial injuries may be secured, however, by examination of data compiled by several State agencies. In New York, for example, 3,247 workmen's-compensation cases involving injuries due to woodworking machines were closed during the 4 years 1932–35.[8] These constituted 12.7 percent of the total of 25,565 injuries due to working machines of all types. In Massachusetts, another important manufacturing State with a great diversity of industry, 2,496 (12.5 percent) of the 19,908 injuries reported during a 5-year period as caused by working machines were due to woodworking machines (table 5).

It is thus apparent that a considerable proportion of injuries caused by machines are due to woodworking machinery.

Description of General Hazards

There is almost universal agreement that power-driven woodworking machines are among the most hazardous of all machine tools. It is also recognized that although many of these machines can be guarded, guarding does not eliminate the possibility of injury to persons operating them or assisting in their operation.

The high degree of accident hazard is due to several factors inherent in woodworking machines. One factor is the extremely high speed at which woodworking machines are operated. Another is the sharpness of the cutting tool. A third is the comparative lightness of the material being cut, making possible "kickbacks" of lumber, since the light wood is easily propelled by the revolving saw blade. Light-weight stock, a high-speed machine, and a sharp cutting tool are a combination of conditions which lead to many accidents. The fact that many woodworking machines are hand-fed tends to increase the accident hazard.

Lack of uniformity in the lumber itself is a contributing factor in woodworking-machine accidents. Not only are there variations among different species but also among pieces of lumber of the same species. This lack of uniformity is responsible for many injuries caused by woodworking machines. For example, pieces of thoroughly dried wood can be worked faster than pieces of the same kind not so dry. Thus, an operator cutting dry wood on a ripsaw running at high speed may encounter an improperly seasoned or green piece. Because green lumber tends to pinch a saw running at high speed, an accident may result. Knots or other imperfections in the wood cause many accidents. These defects cannot always be detected, and when a saw encounters them unexpectedly it may cause the wood to kick back or the hand of the operator to be thrown against the cutting tool.

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[8] Appendix B, table IV, p. 46.

The versatility of woodworking machines also contributes to their accident toll. The variety of work done on certain machines makes effective guarding difficult. For example, a saw satisfactorily guarded for ripping is nearly always unguarded when used for cutting rectangular grooves, called dadoes. The fact that many varieties of work can be done on a shaper makes this machine extremely difficult to guard, with the result that it is one of the most dangerous machines in the shop. It is possible to guard veneer clippers when wide pieces are being clipped, but such guarding is often ineffective when narrow widths are required. The various kinds of work that can be performed on a machine make frequent changes in the set-up necessary. Experience has shown that, when a set-up has been changed, accidents often occur while the machine is being tried out before the guard has been replaced.

Many other factors contribute to the hazards of woodworking machines. There is always the possibility of injury in connection with the mechanical power-transmission apparatus, such as belts, pulleys, or gears. When woodworking machines are direct motor-driven there is also an additional electrical hazard. The fact that safe devices for starting and stopping machines, such as a positive action and locking-type belt shifter for belt-driven machines and a stop-and-start button located within easy reach of the operator in the case of motor-driven machines, are not always provided adds another element of hazard, since machines not provided with them cannot be immediately stopped. Even after the power is cut off many machines continue to "coast" for some time and many accidents occur because the operator does not realize that the machine is still running. Automatic-feed machines, which are safer than the manual-feed type, are not always provided even where the work is of such nature that they could be used. Although it is absolutely essential for safety that clear aisles and adequate work space both for the operator and the off-bearer be maintained, this is often not done.

Expert maintenance is necessary for woodworking machines and tools. The high speed of their operation causes vibration, which may cause maladjustments leading to accidents. The cutting tools of the machine must be properly sharpened and installed if work is to be performed safely. An improperly ground tool does not cut clean; greater effort is required to push the material through the machine and the danger to the operator is thereby increased.

All these factors have a direct bearing on woodworking-machine accidents and make it essential for operators to be skilled in the safe operation and maintenance of this type of equipment. Unquestionably, experienced adult workers are better qualified to work safely than are young and inexperienced persons.

Hazards of Specific Woodworking Machines

In addition to these general hazards common to all woodworking machines are the hazards particularly related to specific types of machines.

Saws.

Saws are one of the most useful and one of the most dangerous of woodworking tools. Whether they are circular saws, used for crosscutting and ripping, or band, scroll, or jig saws, used for variety work, or whether they are special saws used for dadoing or grooving operations, they are characterized by their sharpness and the high speed of their operation. The chief hazard in connection with the operation of saws is contact with the saw blade. Most circular saws are tensioned to run about 10,000 feet rim-travel per minute [9] and are sufficiently sharp to cut through wood stock easily when operated at normal speed. The effect on a portion of the human body of contact with such a fast moving, sharp device is obvious.

Such accidents are possible for several reasons. Possibly the chief one is the fact that when men work constantly in close proximity to danger, they tend after a time to lose the sense of danger which keeps them on the alert. This happens even in the case of men who are experienced and naturally careful.

Injuries from contact with the saw blade are due to a number of causes. In the case of a circular saw in motion, the space between the teeth shows up much lighter than the solid part of the blade, sometimes seeming to be hardly more than a light blur. This fact makes possible inadvertent contact through the failure to judge properly the distance between the hand and the saw blade. The attention of the sawyer may be distracted or he may be daydreaming. Workers sometimes fail to wait until a saw blade stops before adjusting the saw or the gauge. They sometimes follow the unsafe practice of keeping their left hands on the waste piece of stock while finishing a cut. Cases have been recorded where workers' hands came in contact with the blades of circular saws in spite of the fact that there were hood guards.[10]

Saws are often used to cut small pieces of stock or to cut small pieces of wood from larger pieces of stock. When an operator uses his hands to feed the stock into the saw, he must of necessity bring his hands very close to the sharp, swift moving blade. Many saw injuries are due to this cause. A safer, but less frequent practice, is the use of a pusher stick in place of the operator's fingers to push the stock against the blade. Saw injuries often result when the wrong type of saw is used for a particular kind of work as, for example, doing crosscut work on a ripsaw.

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[9] Uhl, Albert L., Use and Abuse of Circular Saws and Their Relation to Safety. Transactions, 28th National Safety Congress, 1929, p. 701. National Safety Council, Inc. Chicago.

[10] An Analysis of Three Hundred Accidents in Woodworking Factories With Suggestions As to Safe Practice and Suitable Machine Guards, Special Bulletin No. 139, p. 17. State Department of Labor, Albany, N. Y. 1925.

Kickbacks are another source of danger, especially on a circular saw. Kickbacks occur when the saw jams in the wood, instead of cutting easily through the wood stock, and causes the energy of the revolving blade to be imparted to the stock, thus throwing the stock back with great force. Kickbacks may occur because a hard knot or other obstruction in the wood is encountered, because stock is not fed straight or is fed too rapidly, or because of a change of grain. Saws improperly sharpened, jointed, or set, or improperly mounted may cause kickbacks. A saw not equipped with a splitter to prevent the stock from binding on the back of the blade and a saw guard not equipped with kickback dogs or fingers to prevent the wood from being thrown back by the saw may also cause injuries from kickbacks.

Band saws in general are safer to operate than circular saws. They can be guarded more effectively and there is less danger of kickbacks. However, the actual cutting point of the saw cannot be guarded, and serious accidents can and do occur on band saws. Some band saws are equipped with pressure rolls which hold the stock firmly as it is being fed into the saw, thus eliminating some of the hazards of saw operation. However, band saw operators are sometimes injured by having their fingers caught between the board and the feed roll.

Planers, shapers, jointers, molders, and other surfacing machines.

Included within this classification are jointers, molders, matchers, stickers, planers, tongue and groove machines, shapers, fluters, and tenoning machines. All are dangerous to operate although, except for the shaper, fairly effective guards are available. Those fed automatically, such as the planer, molder, and sticker, are safer than those fed manually. If an exhaust system is installed, additional protection is provided by the hood. However, none of these machines can be operated without the possibility of injury.

Hand jointers and planers are hand-fed machines and are extremely hazardous. The hands of the operator must come in close proximity to the cutting knives, and extreme care is necessary to avoid accidents. In order to impart a smooth finish to the stock it is necessary that these machines have very sharp knives and be operated at high speed. Under such circumstances the least contact results in a bad cut. The operator must keep his hands on the stock in order to push it over the knives and to keep it firmly pressed on the table. A number of things, such as striking a knot or a change of grain, taking too heavy a cut, or working on a piece of wood too small to be planed, may cause a worker's hand to be thrown into the knives. The person who operates the planer must give undivided attention to his work and follow the instructions of experienced workmen.

The shaper ranks with the most dangerous of woodworking tools. Its high-speed blades have been responsible not only for the loss of many workers' fingers but also for many deaths. The shaper is exceptionally dangerous because the material being cut usually must be guided by hand. In addition, in order to make a smooth-finish job, the knives must be run at high speed. No effective guard suitable for all shaper operations has been developed, and different guards are necessary for different types of work. Any number of things, such as a knot, a change of direction in the grain, too heavy a cut, or a moment of inattention on the part of the operator may cause the fingers to slip into the knives. Accidents have occurred because knives, worn or improperly set, have been thrown from the revolving spindle, the centrifugal force imparting great speed and force to the flying metal. Accidents on shapers also occur because workers, instead of using a form or jig to hold small pieces of stock, rely instead upon their hands to hold and guide the material. Many injuries result when operators carelessly place their fingers over the edge of the stock on the side where the cut is being made. Workers sometimes push the stock against the cutter too suddenly, thus causing the wood to be thrown to one side and drawing the worker's hand toward the blade. Operation of the shaper requires the utmost caution, care, and good judgment, especially since little mechanical safeguarding can be applied to this machine.

Injuries on planers, molders, matchers, stickers, and other machines of this type generally found in planing mills are due to a variety of causes. Poorly guarded machines permit inadvertent contact with the cutting heads. Sometimes a cutting head works loose and flies out. This may be due to poor set-up work or improper maintenance of the machine and its parts. Molders frequently cut off or deeply lacerate fingers because they try to remove the dust hoods or make repairs before the knives have ceased revolving. Planers sometimes cause kickbacks, often with serious consequences. Many planer injuries occur because the operator fails to shut down the machine before cleaning, adjusting, or repairing it. Planer work generally involves the handling of bulky, heavy boards. As a result, lumber-handling injuries are common among workers at such machines.

Lathes.

Lathes are used for turning—that is, giving a circular or cylindrical shape to a variety of wood products. They range in size from the small machines used to produce broom handles, stair spindles, baseball bats, and similar objects to the huge devices used to peel veneer from logs. All lathes work on the same principle—namely, that of revolving the stock against a stationary or rotary knife or cutting edge.

The chief hazard in the operation of wood-turning lathes results from the tendency of the wood to come loose from the pivots or lathe centers which hold and rotate the stock and to strike the operator or someone near him. Sometimes this occurs because the operator attempts to take too heavy a cut. There is also serious danger to the eyes owing to flying chips. Where hand chisels are used with a tool rest instead of a power feed, extreme care is necessary to keep the chisel from gouging into the wood and being thrown, with possible serious results to the operator.

Where large and heavy stock is centered in the lathe, as in the case of a veneer lathe, there is an additional hazard if the material should slip from its holdings. Its great weight may severely injure the toes and legs of the lathe operator and his helper. There is also the danger of coming in contact with the stationary knives when the worker is centering the log in the lathe. Another possibility is that the knife may fly from the lathe while it is in operation. Such accidents may cause severe injury or death. This type of accident is caused by using knives until they have been ground so short that the bolts cannot hold them. There is also danger that a lathe operator's clothing will catch on and be wound around the revolving material.

There are a number of other types of lathes used to turn out a single article in production quantities. One is the swing-type automatic lathe. This machine is provided with rotary cutters mounted on a shaft and also has a pair of rotary centers. The latter each engage one end of a piece of wood, support it, and rotate it about its center line. The wood stock, supported by the rotary centers, is swung into the path of the rotary cutter knives which have been set to shave away the surface of the wood until the desired shape is achieved. In operating this machine there is the possibility of contact with the rotary cutter knives, which may cause severe lacerations or even amputations. In addition there is danger that the stock may fly loose from the rotary centers or pivots and strike the operator.

Another type is the automatic variety lathe which shapes lengths of square wood stock into such articles as handles, knobs, and spools. The stock is held at one end by a chuck mounted on the end of a horizontal rotary shaft or spindle. The chuck supports and rotates the work. On a small, rail-mounted carriage is a ring that guides the free end of the work, a stationary knife that cuts the rotating square-shaped stock into cylindrical form, another knife accurately ground to shave the wood to its final shape, and a third knife which cuts off the completed article from the stock remaining. These last two knives work automatically. As each article is completed and severed from the stock, the carriage moves toward the stock remaining. This continues until the piece of wood is used. This type of lathe is hazardous because of its three knives, which may cause cuts or amputations. Setting up such a machine requires both skill and caution because of the sharpness of the tools involved. The horizontal spindle or rotary shaft may catch an operator's clothing and twist it around the shaft, thereby drawing him into the machine.

Drilling and boring machines.

These machines drill holes or cut out mortises by means of a chisel drill or cutting chain. In addition to horizontal and vertical drilling and boring machines, chain and chisel mortisers are included in this classification. Since a chisel mortiser is primarily a drill operating within a hollow chisel, the hazards are similar to those of any wood drill. The same is true of a chain mortiser, although the method of removing stock is somewhat different.

Boring-machine bits revolve at high speed and contact with them can result in a bad laceration. Such contact is possible because operators generally keep their hand on the stock while moving it against the revolving bits or, as in the case of some machines of this type, while pressing a pedal which moves the revolving bits to the wood. Unless chucks (devices for holding the drill) without projecting setscrews are used, the sleeve of the operator may become entangled in the chuck. Unless the stock is securely clamped on the table it may revolve with the rotating bit and cause a severe injury.

Sanding machines.

Sanding machines include belt, disc, and drum sanders. Belt sanders are revolving belts with an abrasive surface. They are mounted on pulleys and driven by power. The material to be surfaced is placed against a portion of the revolving belt. Disc sanders are revolving, abrasive discs against which the stock is held by an operator. Drum sanders are revolving drums whose outer surfaces are covered with an abrasive over which the stock to be surfaced is passed. These machines are not so hazardous to operate as many other woodworking machines, such as saws or shapers, but numerous accidents do occur on them. Unless they are equipped with an effective exhaust system, considerable dust is given off. This dust is a mixture of wood dust and abrasives and may be harmful if breathed in appreciable quantities.

Some sanders of the drum type are fed by inserting the stock between two live rolls. With these machines there is danger that the hand of the operator will be caught by the pressure roll on the in-running side. Another hazard is the possibility of severe brush burns, which may become infected; these sometimes occur when the operator comes in contact with the sanding disc, drum, or belt.

Probably the chief hazard from sanders is from the driving mechanism—belts, pulleys, gears, et cetera. These can be enclosed but are frequently left open. The belt of a belt sander offers the same hazard as any transmission belt except that it is usually not so tight, being a driven rather than a driving belt. This belt does not run at so high a speed as a transmission belt and will break more easily if the operator is caught in it.

Nailing machines.

Included within this classification are stapling machines, corrugators, wire stitchers, and basket-making machines, as well as machines which nail or tack. As a class they are not considered so hazardous as some of the other machines used in woodworking plants because they seldom cause injuries resulting in amputations. However, a nail or wire may be driven through the finger or hand of an operator of such machine or of a worker assisting him. The plunger of a nailing machine may injure an operator's hand even when the nail does not pierce the finger. There is also danger to the eyes in the operation of nailing and stapling machines, owing to flying nails or spalls from nail heads. Some nailing- and stapling-machine accidents occur when the machines are accidentally tripped while adjustments are being made. Operation of nailing machines requires some degree of muscular coordination, since they generally are provided with a foot treadle for tripping and the operator must be sure that his hands are in the clear before he trips the machine.

Presses.

Included in the classification of presses are veneer presses, box-board squeezers, wagon-wheel presses, hoop presses, door and blind clamps, and all other clamping machines used for special purposes, as well as printing presses for wood or veneer.

Box-board squeezers, used for making box ends, work on a continuous-operation, high-speed basis. They force together the tongued and grooved ends of the wood stock, and there is danger to the operator of a severely mashed finger or hand should it be caught between the stock and the steel plate which applies the necessary pressure.

Veneer presses, usually hydraulically operated, sometimes endanger a worker's fingers if they are caught between the sheets of veneer. Where hot presses are used there is the added hazard of burns. Other presses, such as hoop presses and clamping machines, may be manually operated or power operated, although the latter are slow acting.

Printing presses used on wood or veneer are usually of the hand-fed, platen type similar to a job press used in printing. Feeding these presses endangers the hands of the operators.

Other woodworking machines.

Included in this group are all other woodworking machines not included in the preceding classifications, such as bark grinders, barkers, log chippers, bending machines, veneer clippers, and veneer cutters. Most machines used for removing or grinding bark employ a rapidly revolving knife or cutting tool. These machines present the same hazards as any others where access to the knife or cutter is possible. Operators of barkers are endangered by the possibility that the logs from which the bark is to be removed may fall when they are being moved or transported. Veneer clippers are of the guillotine-knife type. There is a very grave danger that the cutter may be tripped before the hand of the operator or off-bearer is in the clear. Many veneer clippers are operated without any provision for guarding, making these machines doubly dangerous. This machine is noted for the many cases of injury involving loss of fingers or hands.

All machines of these types are extremely hazardous when operated by young workers who are subject to the hazards due to their own immaturity in addition to the dangers inherent in the machines.

Hazards to Other Occupations

Operators of power-driven woodworking machines, as referred to in this report, include workers who feed material into such machines or who have direct control or supervision over their operation. The hazards of these employments have been discussed previously. In addition to these workers, however, are others who follow occupations involved in the operation of woodworking machines. These employees include those who help the operator to feed material into such machines, those who off-bear (that is, remove machined stock or refuse from the rear or side of the machines), and those who set up, adjust, repair, oil, or clean the machines. The hazards confronting workers engaged in these auxiliary machine occupations are discussed in the present section. Not included within the scope of these auxiliary machine occupations are those of employees who handle the machined lumber for the purpose of routing or moving it to the next operation. This is a handling job, usually consisting of piling on a cart or truck the lumber which has already been removed from the machine by an off-bearer or which has been conveyed from the machine by an automatic conveyor, gravity chute, or other device and pushing the truck to the next operation. Thus an off-bearer tailing a ripsaw may pile box shook on a table after removing it from the saw. Another employee may then put the shook on a hand truck and wheel it to another type of machine for further processing. The second worker is not considered in this report as following an occupation involved in the operation of a power-driven woodworking machine.

Work in lining up stock for an operator also is regarded as not involved in the operation of woodworking machines but consists mainly of handling lumber and piling or arranging it in such a way that the operator can easily feed it into the machine. Such work is very similar to that performed by workers engaged in routing or moving machined lumber to the next operation.

The hazards confronting most of the workers in these auxiliary machine occupations are closely allied to those to which operators are subject and arise largely from the fact that these employees work in close proximity to the machines. Those engaged in helping operators to feed material into planers, jointers, matchers, and similar machines work practically as close to the machine as operators. Such workers may be injured by kickbacks of lumber or by accidental contact with the cutting tool. Where heavy boards are being processed, there is a hazard from lumber handling. In addition, such workers are usually in full charge during the operator's absence and at such times are subject to all the dangers inherent in an operator's job.

The hazards of off-bearing vary with the machine from which the stock is being removed. Off-bearing from a saw table or from the point of operation of any circular saw, whether of the rip or crosscut type, is undoubtedly a dangerous task. When off-bearing is done directly from a saw table, the off-bearer must grasp the stock resting on the table in close proximity to the saw blade as soon as the blade has completed the cut. In so doing the off-bearer may come in contact with the revolving saw with consequent loss of a finger or hand. Such an accident might be due to the off-bearer's miscalculating the distance to the saw when reaching for the stock, to slipping and having his hand drawn into the saw in attempting to save himself from a fall, or to having his hand drawn into the saw when the piece being cut kicks back. Although it is true that the wood is usually thrown toward the front of a saw when a kickback occurs, the off-bearer may be startled or confused and accidentally come in contact with the saw.

Off-bearing from guillotine-action veneer clippers is likewise hazardous. When veneer is being clipped in narrow widths, the off-bearer's hands must come within a few inches of the poised blade in order to grasp the cut stock. The machine is generally operated or controlled by another worker who may inadvertently trip it before the off-bearer's hands are out of harm's way. By its very nature this machine tends to inflict permanent injuries.

In order to eliminate the need for having workers remove machined stock near the saw blade or point of operation, modern saws and veneer clippers are equipped with conveyor belts or gravity chutes which convey the stock to a point considerably removed from the saw table or point of operation. As the stock is cut or clipped the chain or chute moves it to a table or bin where another worker stacks or loads it for carrying to the next machine. This worker is not considered as an off-bearer; he stands at a place removed from the machine itself, and his work consists mainly of handling lumber.

The hazards of off-bearing from other woodworking machines, however, are not so great that they should be classed with the hazards of off-bearing directly from the machines discussed above. Machined lumber emerging from band saws, planers, molders, stickers, and other machines is not removed by off-bearers from the point of operation or directly from the saw table. Rather, the stock comes through pressure rolls or other feed-out devices and is propelled along a groove or table for a considerable distance from the point of operation. Pressure rolls, exhaust hoods, and guards prevent off-bearers from having easy access to the working surface or cutting edge.

Some hazardous woodworking machines are usually operated without off-bearers. Among these are shapers, many types of drilling and boring machines, lathes, jointers, and belt sanders.

Workers whose duties include cleaning, oiling, or adjusting machinery are in danger of contact with the sharp cutting edge of the tool. They face the danger of having their hands caught by gears or of coming into contact with the belts, pulleys, or shafting which constitute the power-transmission apparatus. Many workers in these occupations are hurt when they attempt to make repairs or adjustments while the machine is running.

It may properly be concluded, then, that workers who help the operator feed material into power-driven woodworking machines, those who set up, adjust, repair, oil, or clean them, and those engaged in off-bearing from the table or point of operation of a circular saw or veneer clipper have jobs as hazardous as the jobs of workers who operate power-driven woodworking machines. If such jobs are to be performed in a reasonably safe manner, they require mature, experienced, responsible workers.

Statistical Evidence of the Hazards of Power-Driven Woodworking Machines

To the extent that they are available, statistical data on injuries caused by power-driven woodworking machines confirm practical knowledge that occupations involved in the operation of such machines are hazardous. These data show that injury rates in industries in which woodworking machines are used extensively are high in comparison with similar rates for manufacturing as a whole. Furthermore, the statistics available show that woodworking machines as a group are among the most hazardous of all working machines. Finally, these data illustrate the comparison between the hazards of woodworking machines of various types. The statistics presented in this section are based on figures published by the State agencies administering the workmen's compensation laws in New York, Massachusetts, and Virginia, States in which the woodworking industries are of importance; another source of information used is the annual industrial-injury surveys of the United States Bureau of Labor Statistics.

Industrial-injury rates in industries in which woodworking machines are extensively used.

Industrial-injury rates in the wood-products industries, in which woodworking machines are extensively used, are higher than rates for manufacturing as a whole. Although these rates are based upon all occupations in these industries and not merely upon those involved in the operation of woodworking machines, their magnitude is to be attributed to the presence of dangerous machines. Not only are the frequency and severity rates for these industries high but a large proportion of the injuries result in permanent partial impairment, a type of disability typically associated with injuries caused by woodworking machines.

The best source of Nation-wide figures showing the comparison of industrial-injury rates for the wood-products industries with those for all manufacturing is the annual industrial-injury surveys of the Bureau of Labor Statistics. These provide data for computing industrial-injury rates for planing mills and furniture factories and for comparing them with those of all manufacturing industries for the 3 years 1936–38. The frequency rate of disabling injuries for all manufacturing industries for this period was 16.18 injuries per million employee-hours worked.[11] In planing mills power-driven woodworking machines, such as saws, planers, stickers, molders, shapers, jointers, and others, are used extensively, and a large proportion of the workers are engaged in operating them or assisting in their operation. This proportion varies considerably with the size of the planing mill, but in the typical establishment it is estimated to be about two-thirds of all the employees. This industry ranks ninth among 79 industries listed in descending order of their frequency rates for all disabling injuries for the 3-year period.[12] Its frequency rate is 31.74 per million man-hours worked, nearly twice as high as the rate of 16.18 for manufacturing as a whole.

Power-driven woodworking machines are also used extensively in the furniture industry. However, because of the many gluing, assembling, finishing, and inspecting jobs found in furniture factories the proportion of machine operators in this industry (about 25 percent of all the workers) is smaller than in most wood-products industries. Most of the occupations in furniture factories not involved in the operation of power-driven woodworking machines do not appear to be especially hazardous, although some occupations, such as spray painting, undoubtedly involve exposure to conditions which menace the health of the workers. Despite the large proportion of furniture occupations which appear to be relatively free from accident hazards, the frequency rate of industrial injuries for furniture manufacturing for the 3-year period 1936–38 was 19.14 as compared with a rate of 16.18 for manufacturing as a whole (table 4).

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[11] The frequency rate is the number of disabling industrial injuries per million man-hours of employment. A disabling injury is one arising out of and in the course of employment which results in death, in permanent total or permanent partial disability, or in loss of time on any day other than that on which the accident occurred.

[12] The 79 industries to which reference is made include 69 manufacturing and 10 nonmanufacturing industries.

TABLE 4.—*Industrial-injury rates for planing mills, furniture-manufacturing industries, and all manufacturing industries; United States, 1936–38* [1]

Item	Planing mills [2]	Furniture manufacturing	All manufacturing industries [3]
Frequency rate: [4]			
All injuries	31.74	19.14	16.18
Fatal injuries	.16	.06	.10
Permanent partial injuries	3.15	2.19	1.13
Severity rate [4]	4.33	2.56	2.01
Number of injuries:			
All injuries	6,538	10,164	341,348
Fatal injuries	32	32	2,098
Permanent partial injuries	648	1,162	23,768
Number of man-hours of employment	206,000,000	531,000,000	21,096,000,000
Number of days lost	892,756	1,358,767	42,406,615

[1] Based on disabling injuries occurring during the 3-year period 1936–38 in establishments included in the annual surveys of industrial injuries in the United States, made by the U. S. Bureau of Labor Statistics. A disabling injury is one which results in death, permanent total or permanent partial disability, or the loss of time on any other day than that on which the accident occurred.

[2] Includes independent planing mills, planing mills operated in connection with sawmills, and plywood mills. The injury data for these 3 classifications are not separable.

[3] Includes planing mills and furniture-manufacturing industries in addition to all other manufacturing industries.

[4] The frequency rate is the number of injuries per 1,000,000 man-hours of employment. The severity rate is the number of days lost per 1,000 man-hours of employment. For the standard scale of time charges used in computing the severity rate, see The American Standard Method of Compiling Industrial Injury Rates, American Standards Association, approved Apr. 19, 1937. Because of difficulties in evaluating and assigning time charges to cases of permanent partial disability when less than full impairment has occurred, the Bureau of Labor Statistics rates every permanent partial disability at its full value instead of charging a percentage of the full-time charge for partial loss of a member or partial loss of the use of a member.

Compiled from annual surveys of industrial injuries made by the U. S. Bureau of Labor Statistics, 1936–38

Woodworking machines seem to be the chief reason for the magnitude of this rate, for available data indicate that such machines are responsible for a large proportion of the injuries in the furniture industry. In the State of Virginia, for example, there occurred 1,425 compensable accidents in the furniture industry during the 6 years 1933–38 inclusive. Of these 599, or 42.0 percent, were due to mechanical causes.[13] The high proportion of injuries due to mechanical causes in an industry in which only about one-fourth of the workers are employed at woodworking machines indicates that these machines are the chief contributing factor to injuries in the furniture industry. A further indication is the fact that only 20.6 percent of the compensable injuries in all manufacturing in Virginia during these 6 years were due to mechanical causes, as compared with 42.0 percent of the injuries in the furniture industry.[14]

Injuries sustained by workers in industries which utilize a large number of woodworking machines tend to be severe. Many of these injuries result in amputations, thus permanently disabling those injured. The high severity rates characteristic of the wood-products industries and the high frequency rates of permanent partial injuries reflect the seriousness of injuries inflicted by woodworking machines. Compared with the severity rate of 2.01 days lost per thousand man-hours worked in all manufacturing industries combined, the corresponding rate for planing mills, in which many workers operate or assist in operating woodworking machines, was 4.33; the rate for furniture manufacturing was 2.56. The relatively high severity rates of these industries is accounted for in part by the great proportion of permanent partial injuries, chiefly amputations, inflicted by the sharp cutting edges and high-speed operation of power-driven woodworking machines. In the furniture industry there were 2.19 permanent partial injuries, and in planing mills there were 3.15 permanent partial injuries per million man-hours of employment; in manufacturing as a whole, however, the frequency rate of permanent partial cases was only 1.13. (Table 4.)

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[13] Compiled from Biennial Report of the Industrial Commission of Virginia, tables 6, 7: 1933–34, pp. 11–14; 1935–36, pp. 14–17; 1937–38, pp. 16–19. Richmond.

[14] Ibid.

Not only the data compiled from the annual industrial-injury surveys made by the Bureau of Labor Statistics but also information assembled from the reports of industrial injuries based on experience with workmen's compensation in several States where the woodworking industries are important, indicate that high injury rates are characteristic of industries in which power-driven woodworking machines are used extensively.

In the State of Virginia, the frequency rate for all manufacturing was 20.14 injuries per million man-hours worked for the 5-year period 1934–38. For the wood-products industries as a group the corresponding rate was 31.63, half again as great. Within the wood-products group the rates for individual woodworking industries ranged from 22.83 for furniture to 52.98 for box shook and boxes (appendix B, table I, p. 44.) The smaller proportion of machine operators in the furniture industry probably accounts for the disparity between its frequency rate and that for other wood-products industries. No corresponding data related to severity of injuries in these industries in Virginia are available.

Data on industrial injuries in Massachusetts indicate that persons working in wood-products industries in that State have been subject to severe and often permanent injuries. Although this State publishes no data which would permit the computation of frequency or severity rates, an analysis of the industrial injuries reported during the 5-year period from July 1, 1933, through June 30, 1938, indicates that injuries suffered by workers in the wood-products industries tended to result in a larger proportion of permanent impairments than those occurring to workers in all manufacturing industries. In the case of the latter, 38.2 in each thousand were permanent partial injuries. For lumber and its remanufacture 69.6 in each thousand injuries resulted in the amputation or permanent loss of use of a member. Within this group the proportion of permanent partial impairments in each thousand injuries varied from 59.1 for sawmills and planing mills to 75.1 for box-making concerns (appendix B, table II, p. 44).

In New York State statistics based on compensated cases closed during the 5-year period 1933–37 show that 265.6 in each thousand in all manufacturing industries were permanent partial disabilities as compared with 428.7 in planing mills, 428.6 in box factories, 348.7 in furniture factories, and 305.2 in wood-turning and pattern-making factories (appendix B, table III, p. 45).[15]

Statistics of injuries due to woodworking machines compared with those from other working machines.

Not only are the industries in which woodworking machines are used characterized by relatively high industrial-injury rates, but woodworking machines considered as a group rank with the most dangerous of power-driven machines. Work at or near all kinds of working machines is generally regarded as hazardous. Moving parts, whose cutting or crushing action may cause severe injuries to anyone unfortunate enough to come in contact with them, power-transmission apparatus (belts, gears, shafts, and pulleys), and the possibility that in adjusting or repairing such machines a mishap may occur make all working machines a source of danger to persons working at or near them.

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[15] Because of differences in the workmen's compensation laws and in the statistical bases used, these rates cannot be compared with those for Massachusetts.

As has been stated previously, work at or near power-driven woodworking machines is especially hazardous. The high speed of the woodworking tool, the lightness of the stock, the necessarily close proximity of the operator's hands to the point of operation, and the difficulty of guarding many woodworking machines help to make them especially dangerous.

The possibility of severe injuries from work at or near machines in this category is shown by data compiled from reports of industrial-accident commissions in two States. According to industrial-injury statistics compiled from Massachusetts data, woodworking-machine injuries resulted in a higher proportion of permanent partial disabilities than did injuries sustained on any other type of working machine. Of every 100 injuries caused by working machines of all types reported during this period, 12.1 resulted in permanent partial impairment. For woodworking machines there were 18.5 cases of this type of disability in each 100 injuries. This proportion exceeded that of each of the other 11 types of working machines for which the proportion of permanent partial injuries are shown. (Table 5.)

TABLE 5.—*Extent of disability caused by specified working machines; Massachusetts*

[Based on tabulatable injuries reported during the 5-year period July 1, 1933, to June 30, 1938 [1]]

Type of working machine	Total	Fatal and permanent total injuries		Permanent partial injuries		Temporary total injuries	
		Number	Percent	Number	Percent	Number	Percent
All working machines	19, 908	46	0. 2	2, 410	12. 1	17, 452	87. 7
Woodworking [2]	2, 496	7	. 3	462	18. 5	2, 027	81. 2
Chemical products	79	--------	(3)	16	(3)	63	(3)
Clay, glass, and stone products	110	--------	--------	8	7. 3	102	92. 7
Clothing	650	1	. 2	10	1. 5	639	98. 3
Food products	1, 233	1	. 1	147	11. 9	1, 085	88. 0
Metalworking	5, 637	13	. 2	790	14. 0	4, 834	85. 8
Leather products	2, 301	1	(4)	170	7. 4	2, 130	92. 6
Leatherworking—tanneries	661	4	. 6	51	7. 7	606	91. 7
Paper products	678	1	. 1	71	10. 5	606	89. 4
Paper making	536	3	. 6	46	8. 6	487	90. 8
Printing and bookbinding	543	--------	--------	64	11. 8	479	88. 2
Textile	4, 192	12	. 3	450	10. 7	3, 730	89. 0
Rubber, celluloid, composition, pearl, bone, and tortoise shell	765	3	. 4	121	15. 8	641	83. 8
All other machines	27	--------	--------	4	(3)	23	(3)

[1] Tabulatable injuries are industrial injuries, both compensable and noncompensable, which result in death, permanent total or permanent partial disability, or the loss of at least 1 day or shift.

[2] Excludes brush- and broom-making machines and cork-working machines, classified under "all other machines" because they are not regarded as woodworking machines in this report.

[3] Percent not shown because the basic number is too small to make the percent significant.

[4] Less than 1/10 of 1 percent.

Compiled from annual reports of the Massachusetts Department of Industrial Accidents, Boston.

Data on compensated industrial-injury cases closed in New York during the 4-year period 1932–35 lead to a similar conclusion. In that State 567.6 injuries in each thousand caused by woodworking machines, as compared with 359.2 injuries in each thousand caused by other types of working machines, were cases of permanent partial disability. The hazards of employment on power-driven woodworking machines and the seriousness of injuries suffered during the course of such employment become further apparent from a comparison of the average number of weeks lost per case as the result of woodworking-machine injuries with the loss of time occasioned by injuries due to other working machines. Injuries due to woodworking machines in New York caused an average loss of time of 31.6 weeks per case. Those due to other working machines caused an average loss of 19.2 weeks.[16] (Table 6.)

TABLE 6.—*Extent of disability and average number of weeks lost per case for industrial injuries caused by woodworking and all other working machines; New York*

[Based on compensated cases closed during the 4-year period 1932–35]

Type of working machine	Disability distribution per 1,000 injuries			Average number of weeks lost per case [3]	Number of injuries			
	Fatal and permanent total	Permanent partial [1]	Temporary [2]		All injuries	Fatal and permanent total	Permanent partial [1]	Temporary [2]
Woodworking [4]	4.6	567.6	427.8	31.6	3,247	15	1,843	1,389
All other	3.0	359.2	637.8	19.2	22,318	68	8,017	14,233

[1] Includes also facial disfigurement.

[2] Includes temporary total and temporary partial disabilities of 7 or more days duration.

[3] The time charges in New York State are 1,000 weeks each for death and permanent total disability, and the actual number of weeks of compensation awarded for permanent partial and temporary disabilities.

[4] Excludes brush- and broom-making machines and cork-working machines, classified under "all other" because they are not regarded as woodworking machines in this report.

Compiled from Special Bulletin No. 196, New York State Department of Labor, Albany.

It is evident from these data that there is a greater possibility that a worker injured by a power-driven woodworking machine will suffer a handicap for life than a worker injured by any other type of working machine.

Statistical data on hazards of specific types of woodworking machines.

Further evidence of the hazardous nature of various types of woodworking machines is contained in data on the number and types of injuries which they cause. Available statistics indicate the relative importance of the machines as sources of injury and reflect the seriousness of injuries inflicted by woodworking machines. Unfortunately they do not show the number or severity of injuries in relation to exposure, as it has been impossible to make any estimate of exposure. Furthermore, data on the number of woodworking machines in use are not available.

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[16] No direct comparison can be made of the industrial-injury statistics of one State with those of another. This is partly because the workmen's compensation laws of the States are so different in their coverage and partly because the States use widely different bases and methods in tabulating their statistics. The New York figures, for example, are useful only for making comparisons between categories based on New York statistics.

The importance of saws as a source of injury is well known. In New York during a 4-year period, 1932–35, 3,247 compensation cases were closed in which injury was due to power-driven woodworking machines. Of these 1,526, or 47 percent, were caused by saws (table 7). In Massachusetts, statistics on industrial injuries reported during the 5-year period, July 1, 1933, to June 30, 1938, show that saws were responsible for 53 percent of the 2,496 injuries caused by power-driven woodworking machines (table 8). The large proportion of injuries due to saws reflects the facts that they are one of the most frequently used of woodworking-machine tools and that they are extremely hazardous.

TABLE 7.—*Percent distribution of industrial injuries caused by woodworking machines, disability distribution per 1,000 injuries, and average number of weeks lost per injury, by type of machine; New York State* [1]

[Based on compensated cases closed during the 4-year period 1932–35]

Type of woodworking machine	All injuries		Disability distribution per 1,000 injuries			Average number of weeks lost per injury
	Number	Percent	Fatal and permanent total	Permanent partial [2]	Temporary [3]	
All woodworking machines [4]	3,247	100.0	4.6	567.6	427.8	31.6
Lathes	70	2.2	----------	585.7	414.3	15.4
Saws	1,526	47.0	5.9	593.7	400.4	36.7
Saws—band, scroll, and jig	93	2.9	----------	634.4	365.6	18.3
Saws—circular and not elsewhere classified	1,433	44.1	6.3	591.1	402.6	37.9
Planers, shapers, molders, and other surfacing machines, including tenoners	844	26.0	1.2	590.0	408.8	26.4
Planing, molding, and tenoning machines	595	18.3	----------	598.3	401.7	22.7
Shapers	249	7.7	4.0	570.3	425.7	35.1
Sanding machines	65	2.0	----------	384.6	615.4	17.9
Drilling and boring machines, including mortisers	82	2.5	----------	426.8	573.2	14.0
Nailing machines	34	1.0	----------	(5)	(5)	(5)
Presses (woodworking)	11	.3	----------	(5)	(5)	(5)
Other and unspecified woodworking machines	615	19.0	8.1	523.6	468.3	33.1

[1] For basic data see table IV, appendix B, p. 46.

[2] Includes also facial disfigurement.

[3] Includes temporary total and temporary partial disabilities of 7 or more days duration.

[4] Excludes brush- and broom-making machines and cork-working machines because they are not regarded as woodworking machines in this report.

[5] Rate not shown because the basic number is too small to make the rate significant.

Compiled from Special Bulletin No. 196, New York State Department of Labor, Albany.

TABLE 8.—*Percent distribution of industrial injuries caused by woodworking machines, and disability distribution per 1,000 injuries, by type of machine; Massachusetts* [1]

[Based on tabulatable injuries reported during the 5-year period July 1, 1933–June 30, 1938 [2]]

Type of woodworking machine	All injuries		Disability distribution per 1,000 injuries		
	Number	Percent	Fatal and permanent total	Permanent partial	Temporary total
All woodworking machines [3]	2,496	100.0	2.8	185.1	812.1
Lathes	57	2.3	----------	105.3	894.7
Saws	1,323	53.0	2.3	192.7	805.0
Band saws	78	3.1	----------	115.4	884.6
Circular saws	529	21.2	1.9	243.9	754.2
Saws not elsewhere classified	716	28.7	2.8	163.4	833.8
Drilling and boring machines, including mortisers	100	4.0	----------	80.0	920.0
Planers, shapers, molders, and other surfacing machines, including tenoners	615	24.7	4.9	240.6	754.5
Planers and molders	440	17.7	2.3	231.8	765.9
Shapers	64	2.6	----------	281.3	718.7
Tenoners and other surfacing machines	111	4.4	18.0	252.3	729.7
Sanding machines	98	3.9	----------	81.6	918.4
Nailing machines	18	.7	(4)	(4)	(4)
Presses	57	2.3	17.5	122.8	859.7
Other woodworking machines	228	9.1	----------	127.2	872.8

[1] For basic data see table V, appendix B, p. 46.

[2] Tabulatable injuries are industrial injuries, both compensable and noncompensable, which result in death, permanent total or permanent partial disability, or the loss of at least 1 day or shift.

[3] Excludes brush- and broom-making machines and cork-working machines because they are not regarded as woodworking machines in this report.

[4] Rate not shown because the basic number is too small to make the rate significant.

Compiled from annual reports of the Massachusetts Department of Industrial Accidents, Boston.

The high degree of hazard associated with work at power-driven saws is apparent from an examination of data on the proportion of permanent partial injuries for which they are responsible. In discussing the hazards of these machines earlier in this report the fact that they are often responsible for amputations of fingers or hands was mentioned. The extent to which they are responsible for this type of injury or other injuries resulting in the permanent disablement of workers is illustrated by New York and Massachusetts statistics on saw accidents. On the basis of statistics for New York shown in table 7, of each thousand saw injuries, 593.7 were permanent-partial-disability cases as compared with 567.6 cases in each thousand for all woodworking-machine injuries. Injuries resulting from all woodworking machines caused an average time loss of 31.6 weeks per case. Injuries due to saws, on the other hand, caused an average loss of time of 36.7 weeks, more than that caused by any other type of woodworking machine. In Massachusetts, too, injuries from saws resulted in permanent partial disability oftener than did injuries due to all woodworking machines. In the case of all woodworking machines 185.1 injuries in each thousand resulted in permanent impairment or loss of a member; for saws of all types this proportion was 192.7; and for circular saws it was 243.9 (table 8). It must, of course, be borne in mind that because of the difference in statistical bases referred to above, the permanent-partial-disability rates per thousand injuries and the average time lost per injury in

Massachusetts are not directly comparable with the corresponding rates and averages in New York.

Accidents due to planers, shapers, molders, and other surfacing machines, including tenoners, were both numerous and severe. With the exception of the shaper, most of these machines do not have their working tools exposed in the same manner as a saw blade and are somewhat less likely to injure a workman. Nevertheless, the accidents which do occur appear to be severe. The knives of the cutter head of a planer or molder revolve at a high speed. If for any reason a workman's hand is placed in contact with them, the result is likely to be as serious as a saw injury. Statistics on injuries in New York and Massachusetts confirm this statement. In the former State 590.0 injuries in each thousand caused by planers, shapers, molders, and other surfacing machines, including tenoners, were permanent partial cases, compared with 567.6 for all woodworking machines (table 7). In Massachusetts 240.6 injuries in each thousand caused by these machines resulted in this type of disability, compared with 185.1 in each thousand caused by all woodworking machines (table 8).

As was previously indicated, the shaper is an extremely hazardous machine because of its high speed of operation, its exposed knives, and the difficulties of guarding it. One indication of the seriousness of the injuries this machine inflicts is the fact that in New York State the average number of weeks lost due to shaper injuries was 35.1 compared with 22.7 for injuries due to planing, molding, and tenoning machines and 31.6 for those due to all woodworking machines. In that State shapers were responsible for 8 percent of the woodworking-machine injuries. (Table 7.)

Drilling and boring machines cause comparatively fewer serious injuries than other woodworking machines. These machines cause fewer amputations than many other woodworking machines, although an infected injury caused by a drill or boring machine may lead to the loss of a member. A greater proportion of the injuries caused by this type of machine than those caused by most of the other types were temporary disabilities, and the duration of disability resulting from drilling- and boring-machine injuries tended to be shorter than from injuries due to other woodworking machines.

Similarly, sanding machines tend to inflict temporary rather than permanent disabilities. The abrasive surfaces of sanders cause injuries which, although painful, tend to heal in time, and the absence of sharp cutting tools lowers the possibilty of amputations.

Because many lathes are equipped with stationary knives, lathe injuries also tend to result in temporary rather than permanent disabilities. Contact with a stationary knife may inflict a deep, serious cut, but only occasionally will it result in the loss of a member. Automatic and swing-type lathes, equipped with rotary knives, probably tend to cause more permanent injuries than wood-turning lathes.

DANGERS OF WOODWORKING MACHINES FOR YOUNG WORKERS

Since power-driven woodworking machines are dangerous by their very nature, most occupations involved in their operation should be followed only by well-qualified workmen who will perform their tasks in a safe manner. As a rule, young workers are not qualified to operate power-driven woodworking machines safely. The occupations of helping the operator to feed material into power-driven woodworking machines and of setting up, adjusting, repairing, oiling, or cleaning these machines also require well-trained workers if there is to be a minimum of risk in their operation. Likewise, off-bearing from circular saws and clippers can be safely entrusted only to those persons who have the attributes of safe workmen.

Although the attributes of safe workmen are numerous, there are a few which probably are of outstanding importance for those employed at woodworking machines. Employees working at such machines should be experienced; they should have good judgment; they should possess the ability to give their undivided attention to their work; and finally, they should be cautious by nature. The absence of any one of these four attributes makes work at or near woodworking machines exceptionally hazardous.

The lack of experience, which includes not only a knowledge of woodworking machines and their behavior under given circumstances but also a knowledge of the qualities of different types of wood, is an outstanding cause of injury. New employees are generally more prone to accident than older workers because they have not had time to become thoroughly familiar with the machines on which they are working. Workers with little or no experience are usually not so calm or quick to react when an emergency arises as are experienced hands. Many accidents on woodworking machines "occur to men who are put on jobs with which they are not familiar. * * * Injuries often occur when men from one department attempt to do jobs on a machine in another department."[17] An inexperienced worker is more likely to keep his body directly in line with a circular saw instead of to one side and thus be menaced by kickbacks or he is likely to investigate an improperly working planer while it is in motion.

Good judgment is essential for maximum safety on woodworking machines. The use of the proper guard on such machines as shapers, where the guard varies with the work performed, is largely a matter of judgment. Good judgment will prompt a worker to stop immediately a molder, planer, or other machine which "doesn't sound right"; poor judgment may lead him to keep the machine in operation until an accident occurs. A worker with good judgment will feed a green piece of lumber or a warped board into a woodworking machine with due regard for the fact that the condition of the lumber requires special handling. An inexperienced employee will probably handle all stock in the same manner.

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[17] Wilson, J. C., Safety Chips. Transactions, Twenty-eighth Annual Safety Congress, 1939, p. 711.

Essential for workers in woodworking machine occupations is the ability to give undivided attention to their jobs. The closeness of parts of the operator's or off-bearer's body to the cutting edges of the tools of most woodworking machines requires that his attention be riveted on the task at hand. This is made difficult by the monotony of constant repetition of motion required in most woodworking machine occupations and by the noise and other distractions present in a woodworking shop. A moment's inattention while working at a woodworking machine may result in an accident.

Finally, the attribute of caution is one which should be present before a worker can be considered to be reasonably well equipped to operate or assist in operating power-driven woodworking machines. Caution would dictate the strict observance of safety rules and the use of mechanical safeguards, no matter how short the duration of use of the machine. A cautious worker will respect the dangerous nature of his machine. He will make sure that a machine has stopped running before he starts to adjust it, to clear away dust or refuse from working parts, or to investigate a mechanical defect. He will see that aisles near the machine and working space around it are kept clear of refuse, waste stock, and scrap lumber so that neither he nor his fellow workers are in danger of tripping and falling into a machine.

These attributes are characteristically lacking in young workers. Those under 18 years of age are generally new employees and have not had time nor opportunity to acquire the necessary experience to work at these machines with comparative safety. Judgment, so necessary in this work, is also an attribute usually developed with age and experience and, although there are exceptional cases, this trait is not usually fully developed in workers under 18 years of age.

Young workers characteristically find it difficult to give their full attention to one task for long periods. This is especially true in the case of woodworking machines because of the monotonous, repetitive nature of the work. Recklessness, rather than caution, is characteristic of young workers. This trait is often abetted by the natural anxiety of a young worker to keep up his share of the job, to produce as much as a more experienced hand, and to show he is worthy of his hire. This tendency often causes young workers to ignore safety rules in the interests of output.

Because these attributes, possessed by safe workmen following occupations involved in the operation of power-driven woodworking machinery, are essential, and because many young workers are likely to be deficient in them, such employments appear to be more hazardous for workers under 18 years of age than for older workers. Off-bearing from woodworking machines with automatic feed-out or conveyor devices and the lumber-handling occupations are less intimately and directly involved in the operation of such machines and are subject to a lesser extent to the hazards created by the machine itself. Hence, these employments do not appear to require the same degree of experience, judgment, concentration, and caution as do other woodworking-machine employments and do not appear to be especially hazardous for young workers.

GUARDS FOR WOODWORKING MACHINES AND THEIR RELATION TO ACCIDENTS

Consideration has been given to the nature of the hazards associated with specific types of power-driven woodworking machines. These hazards have long been recognized by manufacturer and worker alike, and both have looked to designers of machinery, and more especially to safety engineers, to design suitable guards which would eliminate many of the hazards. Guards, varying in effectiveness, have been invented for some machines; for others, no effective guards have been produced. In general, the variety of work performed on many of these machines is such that guards cannot be used continually even if provided.

In considering the hazards of employment on woodworking machines for young workers, it is pertinent to inquire whether the known operating safeguards are sufficiently effective and their use sufficiently widespread to reduce the hazards of woodworking machines substantially.

The first conclusion to be drawn from such an inquiry is that although undoubtedly guarding of woodworking machines has been a big factor in reducing the degree of hazard in woodworking employments, it has not eliminated many of the very serious dangers present in their operation; as a result these machines still rank high among hazardous working machines. The second is that there is no universal use, voluntary or in response to legal requirement, of those types of guards that are acknowledged to be effective in reducing hazards.

Woodworking machines are perhaps the most difficult of all machines to guard properly. Many safety engineers are of the opinion that there are few, if any, absolutely fool-proof guards. Most of the machines are used for many different types of work and sizes of stock, and a guard suitable for one type or size is not adequate for another. Guards can be installed on some machines only at a substantial sacrifice in the efficiency of the machine. On certain kinds of work, such as using a dado head on a ripsaw table, the use of a guard is impractical. Most woodworking-machine guards are easily removed, and if an operator feels that one slows up production he may remove it. Sometimes guards, otherwise effective, must be removed to permit adjustment of the machine. Many accidents occur despite the presence of guards because of the failure of workmen to observe safety laws or rules or of management to enforce them. The vice president of a leading casualty insurance company recently observed:

> Unfortunately laws are ignored, rules are broken or not enforced, and saws and machines, gears and belts remain the same serious menace to the workers in hundreds of plants that they were 25 years ago.
>
> Mechanical safeguarding, even though strictly enforced, is not enough to stop accidents in any industry. Why? Because we still have the human element to contend with. I am still firm in my belief that the best safety device known is a careful workman.[18]

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[18] Safety Chips, p. 709.

Furthermore, even where adequate types of guards exist there are many plants and areas where they are not used. There is no universal requirement that the point of operation of power-driven woodworking machines be adequately guarded. In fact, a National Safety Council analysis of State legal requirements for guarding of certain machines indicates that in 1935 only 23 States either by statute or regulation definitely required that guards be provided on woodworking machines.[19] It is legally permissible in many States to operate power saws, planers, jointers, et cetera, without any kind of guard.

In many of those States where guarding is required there are no standard specifications as to what constitutes an adequate guard. Although some State regulations give detailed specifications as to how guards should be constructed, others only state the performance to be expected from the guard, and still others simply state that the machine must be "adequately" guarded or made "reasonably" safe. In a few States official approval by some agency, usually the State labor department, is required before the type of guard is considered as meeting the State standard, but in most States acceptance of guards is left entirely to the inspector. The result of this lack of standardization is that types of guards acceptable in some States may not be used in others and guards accepted by one inspector may be considered unsatisfactory by another inspector within the same State. This lack of standardization in the use of approved guards for woodworking machines will probably exist until there is far wider use of standard safety codes developed on a national basis.

In States where guards are required, their continuous and proper use is a problem of enforcement that rests on the State labor department or industrial-accident commission. Experience shows that such standards are not self-enforcing. These agencies are usually understaffed; consequently, sufficient inspections cannot be made to assure that guards, even though required, are always used.

Variations in the effectiveness of guards and in the extent to which guards are used where adequate types are available make unsound complete reliance on them for the protection of young workers at woodworking machines.

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[19] State Safety Requirements in Industry. Safe Practices Pamphlet No. 94. National Safety Council, Inc. Chicago, 1935.

MINIMUM-AGE STANDARDS

That work as operator of or off-bearer from many power-driven woodworking machines is hazardous has received widespread recognition. Legal regulations in many States, the N. R. A. codes, and minimum-age standards self-imposed by many manufacturers are indicative of the cognizance taken of the dangers of work at or near these machines.

The following discussion summarizes first the legal provisions governing the employment of minors on power-driven woodworking machines, the provisions of the N. R. A. codes governing the employment of minors in the woodworking industries, and, finally, the attitudes expressed by employers, trade-union representatives, and labor-law administrators regarding the employment of young persons.

Legal Regulation of the Employment of Minors on Woodworking Machines[20]

Workers up to 18 years of age are not adequately protected by State legislation from the hazards of woodworking-machine employments, only 3 States having established a minimum-age standard as high as 18 for the operation of any woodworking machines. Despite the inadequate protection afforded by the laws of most States, however, there has been widespread legislative recognition that employment on power-driven woodworking machines involves special hazards. This is indicated by the fact that in 23 States minimum-age standards for employment on woodworking machines are higher, usually by 2 years, than those fixed for general employment. In thus protecting minors from employment at these machines beyond the minimum age permitted for entrance into industrial employment, these States have followed the pattern common to child-labor legislation in this country, which has long embodied the principle of special protection to young persons from hazardous employment.

In 20 of these 23 States employment of minors under 16 years of age on woodworking machines is prohibited; this minimum age is 2 years beyond the 14 years fixed in these States as the minimum age for general employment.[21] In most of these States, the 16-year minimum age applies to employment on specified woodworking machines. In one (Maryland) it applies also to any machine operated by power other than hand or foot power. In another (Missouri) most woodworking-machine employments would be embraced within the 16-year minimum age specified for the operation of all power machines except those used for agricultural purposes or in domestic service.

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[20] State laws as of January 1, 1941, and regulations under State laws up to January 1, 1939.

[21] Alabama, Arizona, Arkansas, California, Colorado, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Maryland, Minnesota, Missouri, New Mexico, North Dakota, Oklahoma, Tennessee, Vermont, and Wyoming.

In 2 of the 23 States (New Jersey and Pennsylvania) the basic minimum age is 16 for general employment and in one State (Michigan) the basic minimum is 15 years. In all of these States the minimum age for employment on woodworking machines is 18 years. New Jersey specifically prohibits the employment of minors under 18 on any power-driven woodworking machinery. In Michigan and Pennsylvania the employment of minors under 18 years on power-driven woodworking machinery "in woodworking shops" is forbidden by ruling under the State child-labor law, and the extent to which these prohibitions apply to all woodworking machines is dependent upon the interpretation of "woodworking shops." Exceptions for bona fide apprentices working under proper supervision are provided in Pennsylvania and New Jersey.

The laws of most of the States which prohibit employment of minors up to 16 years of age on specified woodworking machines were enacted during a period when the standard generally embodied in State child-labor legislation was a 14-year minimum age for general employment and a 16-year minimum age for work in hazardous occupations. Within more recent years the trend in legislation, as indicated by the standards incorporated in the Fair Labor Standards Act and recent State child-labor legislation, has been toward the establishment of higher standards both for general employment and for work in hazardous occupations. Usually this has included a minimum age of 16 for factory employment at any time; of 16 for employment in any occupation during school hours, with employment permitted at 14 years in nonfactory work outside school hours; and a minimum age of 18 for employment in hazardous occupations.

As a result of this trend toward greater protection for young workers, 13 States now have a basic minimum age of 16 years. While only 2 of these 13 States (Pennsylvania and New Jersey) have an 18-year minimum-age standard for employment on some or all woodworking machines, it is significant that 7 others (New York, North Carolina, Rhode Island, Ohio, Massachusetts, Utah, and Wisconsin), in addition to the basic 16-year minimum age set for employment, have expressly prohibited employment of minors under 16 on specified woodworking machines or on all power machinery, thereby legally banning any employment on woodworking machines that may not already be covered by the basic minimum age of 16 years. These express prohibitions of employment of minors under 16 on specified woodworking machines indicate further recognition by the State legislatures of the hazardous character of woodworking-machine employments. In 1 other State (Connecticut) the 16-year minimum age applies to employment in any manufacturing, mechanical, or mercantile industry, covering substantially all employments in which woodworking machines would be used. In the remaining 3 States with a basic minimum age of 16 (South Carolina, Montana, and West Virginia) all woodworking machines in factories would be covered by that basic standard.

Appendix B, table VI, shows the extent to which States have set a minimum age for employment on specified woodworking machines that is higher than the minimum age prevailing for general employment. It shows also the machines at which employment under a specified age is most frequently prohibited. These include band and circular saws, planers, slashers, jointers, shapers, wood-polishing, wood-turning, and boring machines. For instance, employment of minors on band saws is prohibited up to the ages indicated by 29 States; on circular saws, by 31 States; on woodshapers, by 29 States; on wood-turning and boring machines, by 27 States. These restrictions on the employment of minors under the ages indicated on specified woodworking machines include those applying to all woodworking machinery, as in North Carolina and New Jersey; to woodworking machines in woodworking shops, as in Michigan and Pennsylvania; and to employment on a number of specified woodworking machines as in many States. Most of the provisions prohibit not only the operation of the woodworking machines but also assisting in the operation of such machines, although in 2 States (Vermont and Wyoming) only "operation" is prohibited.

Although the hazards of woodworking-machine employments are widely recognized, young workers are not protected from them to the extent to which the hazards involved require. Not only may children as young as 16 work in these employments in many of the States, but in 2 States (Maine and Texas) minors 15 years old and in 12 States[22] minors 14 years old may be employed on woodworking machines either in factories or elsewhere. In some of these States children even younger than 14 may be so employed, since under the law exemptions permit work under certain conditions, such as during vacation or because of the child's poverty.

N. R. A. Code Provisions

Under the provisions of 331 N. R. A. codes, the code authorities were required to submit to the National Recovery Administration lists of occupations which were deemed to be particularly hazardous for minors under specified ages and from which such minors should be excluded. In a number of lists, woodworking-machine employments were included. In order to assist the code authorities in making these determinations, the Labor Advisory Board requested the Industrial Division of the Children's Bureau of the United States Department of Labor to develop for its guidance appropriate lists for each industry. The lists developed by the Bureau and the Labor Advisory Board were based primarily upon the unanimous findings of an Advisory Committee on Employment of Minors in Hazardous Occupations which had been appointed by the Bureau on the recommendation of the 1930 White House Conference on Child Health and Protection. This committee, which in 1932 had issued a comprehensive report on occupations hazardous for the employment of minors, was composed of 19 members who were specialists in industrial safety and health hazards, in the administration of labor laws, or in child health or welfare.[23] This basic material was supplemented by reference to such other studies as were available and by consultation with experts in particular industries, including labor and industry representatives on the code authorities. The recommended lists of hazardous occupations were transmitted to the various industry code authorities through the Labor Advisory Board and the deputy administrator in charge of the code.

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[22] Idaho, Iowa, Kansas, Louisiana, Mississippi, Nebraska, Nevada, New Hampshire, Oregon, South Dakota, Virginia, Washington. In three of these States (Iowa, Virginia, and Washington) employment of minors up to a higher age is prohibited on dangerous or hazardous machines, but no information is available as to whether these provisions are applied to woodworking machines. The employment of minors under 16 in Iowa and under 18 in Virginia is prohibited in operating or assisting in operating any dangerous machinery. In Washington, by an order of the State Industrial Welfare Committee, employment of any person under 18 is forbidden upon or within dangerous proximity to any dangerous cables, rigging, or hazardous machines.

On the basis of the recommendations made by this Advisory Committee, the Children's Bureau and the Labor Advisory Board urged that all occupations in any industry involving operating, assisting in operating, or taking material from power-driven woodworking machines be considered especially hazardous and that such occupations be prohibited for minors under 18 years of age. The code authorities for 40 different industries in which woodworking machines are used adopted this recommendation and included the occupation of operator of or off-bearer from a power-driven woodworking machine in the lists of hazardous occupations which they submitted to the administrator.[24] The adoption of this recommendation by these code authorities constituted a recognition by the various industries represented that such employments were too hazardous for the employment of minors under 18 years of age.

The lumber and timber-products industry included in its N. R. A. code a provision which indicated that the representatives of that industry recognized the hazardous nature of woodworking employments. That code, which covered the production of logs, poles, piling, sawed lumber, products of planing mills, shingles, hardwood flooring, veneers, plywood, kiln-dried hardwood dimension, lath, sawed boxes, shook, and crates, and plywood, veneer, and wire-bound packages and containers, provided that "No individual under 18 years of age shall be employed, except that boys 16 years and over may be employed in the Wooden Package Division and in nonhazardous occupations during school vacations or if there are no wage earners of 18 years or over in their families."[25] The many occupations in this industry involving work as an operator of or off-bearer from power-driven woodworking machines were thus largely barred to minors under 18.

Another code, that for the furniture-manufacturing industry, an industry in which woodworking machinery is extensively used, recognized that some employments in the industry might be dangerous for young workers. This code fixed the minimum age for employment at 16 years but provided that no one under 18 years should be employed at operations or occupations hazardous in nature or detrimental to health. The code authority was required to submit to the National Recovery Administration before January 15, 1934, a list of such occupations. The list submitted by the Furniture Code Authority on January 13, 1934, proposed that persons under 18 years of age be forbidden to operate (but not be forbidden to work as off-bearers from) the following woodworking machines:

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[23] For a list of the personnel of the committee, see appendix D, p. 51.
[24] For a list of these industries see appendix C, p. 49.
[25] Code of Fair Competition for the Lumber and Timber Products Industry, as approved on August 19, 1933, art. V (d), p. 25. National Recovery Administration.

Circular ripsaws, manual feed.
Jointers, or buzz planers.
Circular crosscut saws.
Circular swing saws.
Circular trim or miter saws.
Spindle carvers.
Shapers.
Band saws.
Band resaws.
Jigsaws.
Automatic lathes.
Molders or stickers.
Tenoners.
Veneer clippers or shears.
Boring machines.
Hand jointers.
Circular self-feed rip or crosscut saws.
Veneer jointers (saw-head type).
Planers or surfacers.
Drum sanders.
Routers.
Mortisers.

The code authority also proposed to forbid the employment of workers under 18 in shop-maintenance occupations, "particularly including oiling and cleaning machinery, shafting, and belting."

On January 30, 1934, the Labor Advisory Board submitted to the administrator a list of operations and occupations which it considered to be hazardous and at which it recommended that persons under 18 years of age should not be employed in the furniture-manufacturing industry. The recommendations of the Labor Advisory Board were based on those made by the Advisory Committee on the Employment of Minors in Hazardous Occupations. The list included the following:

> All occupations in connection with power-driven woodworking machinery, the prohibition to apply to operating, assisting in operating, or taking material from such machines.
>
> > *Exception.*—Employment on any of these machines may be permitted in the case of minors between 16 and 18 years of age under conditions of bona fide apprenticeship to a trade.
>
> In oiling, cleaning, or wiping machinery in motion.
> In applying belts to a pulley in motion or assisting therein.

Apparently no agreement had been reached between the code authority and the Labor Advisory Board on the occupations to be declared hazardous at the time of the Supreme Court decision declaring the N. R. A. codes unconstitutional.

It is clear, however, that the differences between the recommendations of the Labor Advisory Board and the list prepared by the code authority for the furniture-manufacturing industry were on the question of how far the 18-year age minimum should be extended rather than on the basic recognition of hazards of woodworking machines. The list submitted by the code authority for the furniture-manufacturing industry, although it named specific woodworking machines on which employment under 18 should be barred, included practically all important categories of woodworking machines, whereas the recommendations of the Labor Advisory Board proposed to apply the 18-year minimum to the operation of "all power-driven woodworking machinery." Only with regard to off-bearers was there substantial divergence of opinion, the Labor Advisory Board favoring a prohibition on this work for minors and the code authority opposing one. The provisions of the Lumber and Timber Products Industry Code also constitute recognition of the hazards of woodworking-machine employments.

Attitudes of Employers, Trade Unions, and Labor-Law Administrators

Opinions expressed by representatives of employers and organized workers and by labor-law administrators during the course of this investigation clearly show that the operation of power-driven saws, planers, molders, and other woodworking machines is today, as in the N. R. A. period, recognized to be particularly hazardous for young workers. Nearly all employers and trade-association officials consulted stated that they favored an 18-year age limit for work as operator of any power-driven woodworking machinery. A few employers stated that they would favor excepting from such a ruling the operation of nailing machines in box factories and the operation of stapling machines used in the manufacture of veneer baskets, berry baskets, and berry-crate dividers on the grounds that such machines are not especially hazardous and that injuries occurring during the course of their operation tend to be minor ones.

Opinion was divided among employers and employer representatives consulted as to the hazards of off-bearing from woodworking machines. Nearly all the employers interviewed agreed that young workers engaged in removing stock directly from a saw blade, with their hands coming close to the saw, are engaged in hazardous work. On the other hand, the preponderance of opinion was that the work of boys under 18 years of age working as off-bearers from power-driven woodworking machines in factories equipped with the latest types of machinery is not especially hazardous. Such employment is reasonably safe, in their opinion, because the machines are usually equipped with rolls, conveyors, or slides on which the stock moves until it reaches a table located from 3 to 6 feet from the working portion of the machine, at which point the off-bearer stacks and removes the material.

There was agreement that work at or around veneer lathes and clippers is too hazardous for workers less than 18 years of age and that the operation of barkers or rossers is likewise too hazardous.

Trade-union representatives were practically unanimous in their opinion that operating any power-driven machine is too hazardous for the employment of minors. They stated also that off-bearing from circular saws or from other machines which require that the worker's hands come in close proximity to the point of operation is particularly hazardous for young workers. However, like most of the employers, a majority of the union officials interviewed during the investigation agreed that there are many light lumber-handling jobs in woodworking plants not directly involved in the operation of power-driven woodworking machines at which youths between 16 and 18 years of age may properly be employed without undue danger of injury. Exception to this point of view was taken, however, by one union representative who felt that all employment in woodworking shops in which power-driven machinery is used should be forbidden to minors under 18 years of age.

The large majority of officials of State labor departments and of industrial-accident commissions consulted were also of the opinion that all occupations in operating power-driven woodworking machines and in off-bearing from the point of operation of saws or veneer clippers are very hazardous. Most of these officials have had long experience with the conditions of work on such machines as a result of their work in administering industrial accident and safety laws, and their opinions seemed to be based upon an objective appraisal of this experience.

CONCLUSIONS

1. Power-driven woodworking machines are the cause of a large number of industrial injuries. A considerable number of minors under 18 years of age are employed in occupations involved in the operation of such machines.

2. The relatively high industrial-injury rates in the wood-products industries reflect the hazards of occupations involved in the operation of woodworking machines.

The frequency rate for planing mills, where a large majority of employees operate woodworking machines, was 31.74 injuries per million man-hours worked for the 3-year period 1936–38, compared with a rate for all manufacturing of 16.18. The rate for furniture manufacture, where only about one-fourth of the workers are engaged in operating or assisting in operating power-driven woodworking machines, was 19.14. That many injuries in the furniture industry are due to woodworking machines is indicated by the fact that 42 percent of the injuries in Virginia in the 6-year period 1933–38 were due to mechanical causes, although only about 25 percent of the employees were machine workers.

Rates measuring the severity of injuries in the planing-mill and furniture industries likewise exceed the severity rate for all manufacturing. The severity rate for the furniture industry is 2.56 days lost per thousand employee-hours worked; and for planing mills, 4.33; for all manufacturing the corresponding rate is 2.01. The relatively high severity rates are due in part to the frequency of permanent partial injuries, which are characteristic of those caused by woodworking machines.

3. Injuries inflicted by woodworking machines are likely to be especially severe. A large proportion of them result in amputations or other permanent partial disabilities. They cause an average loss of time greatly in excess of that caused by injuries due to other working machines.

The proportion of permanent partial injuries caused by woodworking machines is higher than that caused by any other type of working machine. In Massachusetts, during the 5-year period from July 1, 1933, to June 30, 1938, for example, 3.8 percent of the injuries from all causes occurring to workers in the manufacturing industries, and 12.1 of the injuries due to all working machines were permanent partial disabilities, but 18.5 percent of the injuries due to woodworking machines were permanent partial impairments.

Data for New York State also reveal the serious character of woodworking-machine injuries. Such injuries caused an average loss of time of 31.6 weeks per case for compensated cases closed during a 4-year period compared with a loss of time of 19.2 weeks caused by injuries due to all other working machines.

4. Power-driven woodworking machines are extremely hazardous because of their sharp cutting edges combined with high operating speeds and because of the necessity for operators and most off-bearers to work in close proximity to moving parts. Mechanical guarding cannot be relied upon to protect workers from the hazards of occupations involved in the operation of these machines because State laws vary widely in their requirements for guards, and because guards are not consistently and continually used.

5. Workers engaged in helping the operator to feed materials into woodworking machines and those engaged in setting up, adjusting,

repairing, oiling, or cleaning power-driven machines have jobs very nearly as hazardous as the jobs of those who operate them.

6. Workers engaged in off-bearing directly from the saw tables of circular saws or directly from the point of operation of guillotine-action veneer clippers likewise are engaged in extremely hazardous occupations.

7. In order to perform their work in a reasonably safe manner, workers engaged in occupations involved in the operation of power-driven woodworking machines must possess experience, judgment, capacity for concentration, and caution. Because these attributes have not been fully developed in young workers, woodworking-machine occupations are especially hazardous for them.

8. Minimum-age standards for employment of young workers imposed by State laws, those voluntarily maintained by employers, and those adopted by N. R. A. Code authorities constitute recognition of the extremely hazardous nature of woodworking-machine employments for young workers.

Three States have established a minimum-age standard as high as 18 years for work on power-driven woodworking machines, and in 20 other States the minimum age of 16 years for such employment is higher than the minimum age for general employment.

Under 40 N. R. A. codes the minimum age for employment as operator or off-bearer from power-driven woodworking machines was 18 years.

Although a few employers consulted during the course of this study were in favor of permitting young workers to act as off-bearers from most or all woodworking machines, nearly all employers and representatives of organized workers in the woodworking industries consulted were of the opinion that the operation of all power-driven woodworking machines was especially hazardous for workers under 18 years of age and many of them voluntarily maintained a minimum age for such employment of 18 years or higher.

Appendix A.—Legal Basis for the Investigation

This investigation has been conducted by the Industrial Division of the Children's Bureau pursuant to the regulation entitled "Procedure Governing Determinations of Hazardous Occupations,"[1] issued by the Chief of the Children's Bureau on November 3, 1938, and to the authority conferred by section 3 (l) of the Fair Labor Standards Act of 1938 (Act of June 25, 1938, ch. 676, 52 Stat. 1060, U. S. Code, Supp. IV, ti. 29, sec. 201), hereafter referred to as the act. This subsection, which defines "oppressive child labor" as that term is used in the act, provides in part as follows:

> (*l*) "Oppressive child labor" means a condition of employment under which (1) any employee under the age of sixteen years is employed by an employer * * * in any occupation, or (2) any employee between the ages of sixteen and eighteen years is employed by an employer in any occupation which the Chief of the Children's Bureau in the Department of Labor shall find and by order declare to be particularly hazardous for the employment of children between such ages or detrimental to their health or well-being; * * *.

For the purpose of establishing an orderly procedure for determining and declaring occupations to be particularly hazardous for the employment of minors between 16 and 18 years of age or detrimental to their health or well-being, the Chief of the Children's Bureau issued the regulation Procedure Governing Determinations of Hazardous Occupations, the first section of which provided in part as follows:

> Sec. 421.1. *Investigation and conference.*—Preparatory to the making of a finding by the Chief of the Children's Bureau that an occupation or a group of occupations is particularly hazardous for the employment of minors between 16 and 18 years of age or is detrimental to their health or well-being, a study shall be made of information obtained by the Bureau, or submitted to it with respect to the hazardous or detrimental nature of such occupation or occupations. Conferences may be held with representative employers and workers in the industry, experts in industrial health and safety, and others for the purpose of discussing the nature and characteristics of the occupation or occupations under consideration. A public hearing may be held upon reasonable public notice of the time and place thereof whenever such action is deemed by the Chief of the Bureau to be expedient for the purpose of obtaining such evidence with respect to the nature and characteristics of such occupation or group of occupations. A transcript of the proceedings of any such hearing shall be made and filed with the Bureau. A report of facts and conclusions with respect to the hazardous or detrimental nature of the occupation or occupations under consideration shall be prepared upon the basis of such information and evidence.

In accordance with the provisions of the act and the regulation referred to, the Chief of the Children's Bureau instructed the Industrial Division of the Bureau to conduct an investigation with respect to the hazardous or detrimental nature of woodworking-machine occupations, with special reference to young workers, and to consider the problems involved in drafting an order under section 3 (l) of the act.

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[1] Procedure Governing Determinations of Hazardous Occupations, Title 29—Labor, Chapter IV—Children's Bureau—Child Labor—Part 421. Federal Register, vol. 3, p. 2640 DI, November 5, 1938.

Appendix B.—Supplementary Tables

TABLE I.—*Industrial-injury frequency rates for woodworking industries (other than sawmills and cooperage) and for all manufacturing industries; Virginia*

[Based on lost-time injuries occurring during the 5-year period 1934–38 [1]]

Industry	Frequency rate [1]	Number of lost-time injuries	Number of man-hours worked
All manufacturing industries [2]	20. 14	25, 188	1, 250, 508, 082
All woodworking industries	31. 63	5, 295	167, 389, 322
Planing-mill products	43. 41	1, 307	30, 107, 194
Box shooks and boxes	52. 98	666	12, 571, 506
Furniture	22. 83	1, 803	78, 964, 983
Veneer and veneer products	32. 00	823	25, 715, 223
All other woodworking industries	34. 75	696	20, 030, 416

[1] Number of lost-time injuries per 1,000,000 man-hours of exposure. A lost-time injury is one resulting in death, permanent disability, or time lost on any day or shift other than that on which injury occurred.

[2] Includes sawmills, cooperage mills, and other woodworking industries in addition to all other manufacturing industries.

Compiled from biennial reports, Industrial Commission of Virginia, Richmond.

TABLE II.—*Disability distribution per 1,000 injuries for lumber and its remanufacture and for all manufacturing industries; Massachusetts*

[Based on tabulatable injuries reported during the 5-year period July 1, 1933–June 30, 1938 [1]]

Industry	Disability distribution per 1,000 injuries			Number of injuries			
	Fatal and permanent total	Permanent partial	Temporary total	All injuries	Fatal and permanent total	Permanent partial	Temporary total
All manufacturing industries [2]	5. 1	38. 2	956. 7	78, 935	403	3, 016	75, 510
Lumber and its remanufacture	4. 5	69. 6	925. 9	4, 466	20	311	4, 135
Box making (wood)	6. 8	75. 1	918. 1	586	4	44	538
Furniture	3. 0	71. 7	925. 3	1, 647	5	118	1, 524
Saw and planing mills	3. 3	59. 1	937. 6	609	2	36	571
Other woodworking [3]	5. 5	69. 6	924. 9	1, 624	9	113	1, 502

[1] Tabulatable injuries are industrial injuries, both compensable and noncompensable, which result in death, permanent total or permanent partial disability, or the loss of at least one day or shift.

[2] Includes lumber and its remanufacture as well as all other manufacturing industries.

[3] Includes the manufacture of pianos, organs, and wood heels, and other wood-products industries not elsewhere classified.

Compiled from annual reports of the Massachusetts Department of Industrial Accidents, Boston.

TABLE 111.—*Disability distribution per 1,000 injuries and average time loss per injury for specified wood-products industries and for all manufacturing industries; New York*

[Based on compensated cases closed during the 5-year period 1933–37]

Industry	Disability distribution per 1,000 injuries			Average number of weeks lost per injury			Number of injuries				Number of weeks lost[1]		
	Fatal and permanent total	Permanent partial	Temporary	All injuries	Permanent partial	Temporary	All injuries	Fatal and permanent total	Permanent partial	Temporary	All injuries	Permanent partial	Temporary
All manufacturing industries[2]	7.7	265.6	726.7	22.7	41.0	5.6	114, 971	884	30, 538	83, 549	2, 607, 596	1, 253, 176	470, 420
Specified wood-products industries	7.4	356.4	636.2	26.8	43.8	5.9	5, 547	41	1, 977	3, 529	148, 385	86, 537	20. 848
Planing mills	13.2	428.7	558.1	39.1	50.9	7.3	1, 136	15	487	634	44, 398	24, 781	4, 617
Cooperage	4.2	294.1	701.7	24.1	50.0	7.4	238	1	70	167	5, 736	3, 500	1, 236
Boxes		428.6	571.4	23.5	44.2	8.0	336		144	192	7, 909	6, 369	1, 540
Wood turning and pattern making	3.5	305.2	691.3	17.3	35.9	4.2	865	3	264	598	14, 984	9, 486	2, 498
Furniture	5.6	348.7	645.7	23.8	41.6	5.8	2, 707	15	944	1, 748	64, 449	39, 265	10, 184
Rattan and willow ware	(3)	(3)	(3)	(3)	(3)	(3)	45		8	37	587	466	121
Veneer goods[4]	31.8	272.7	695.5	46.9	44.5	4.3	220	7	60	153	10, 322	2, 670	652

[1] The time charges in New York State are 1,000 weeks each for death and permanent total disability, and the actual number of weeks of compensation awarded for permanent partial disability, including facial disfigurement, and for temporary total and temporary partial disabilities of 7 or more days duration.

[2] Includes all wood-products industries as well as all other manufacturing industries.

[3] Rate not shown because the basic number is too small to make the rate significant.

[4] Does not include manufacture of veneer.

Compiled from Special Bulletins Nos. 191 and 202, New York State Department of Labor, Albany.

Table IV.—*Number of industrial injuries caused by woodworking machines, according to extent, disability, and number of weeks lost, by type of machine; New York* [1]

[Based on compensated cases closed during the 4-year period 1932–35]

Type of woodworking machine	All injuries	Fatal and permanent, total	Permanent partial [2]	Temporary [3]	Weeks lost [4]
All woodworking machines [5]	3,247	15	1,843	1,389	102,448
Lathes	70		41	29	1,076
Saws	1,526	9	906	611	55,976
Saws—band, scroll, and jig	93		59	34	1,700
Saws—circular and not elsewhere classified	1,433	9	847	577	54,276
Planers, shapers, molders, and other surfacing machines, including tenoners	844	1	498	345	22,265
Planing, molding, and tenoning machines	595		356	239	13,516
Shapers	249	1	142	106	8,749
Sanding machines	65		25	40	1,163
Drilling and boring machines, including mortisers	82		35	47	1,151
Nailing machines	34		8	26	266
Presses (woodworking)	11		8	3	202
Other and unspecified woodworking machines	615	5	322	288	20,349

[1] Basic data for table 7, p. 27.

[2] Includes also facial disfigurement.

[3] Includes temporary total and temporary partial disabilities whose duration is 7 days or more.

[4] The time charges in New York are 1,000 weeks each for death and permanent total disability and the actual number of weeks of compensation awarded for permanent partial disabilities and temporary disabilities.

[5] Excludes brush- and broom-making machines and cork-working machines because they are not regarded as woodworking machines in this report.

Compiled from Special Bulletin No. 196, New York State Department of Labor, Albany.

Table V.—*Number of industrial injuries caused by woodworking machines, according to extent of disability, by type of machine; Massachusetts* [1]

[Based on tabulatable injuries reported during the 5-year period July 1, 1933–June 30, 1938 [2]]

Type of woodworking machine	All injuries	Fatal and permanent total	Permanent partial	Temporary total
All woodworking machines [3]	2,496	7	462	2,027
Lathes	57		6	51
Saws	1,323	3	255	1,065
Band saws	78		9	69
Circular saws	529	1	129	399
Saws not elsewhere classified	716	2	117	597
Drilling and boring machines, including mortisers	100		8	92
Planers, shapers, molders, and other surfacing machines, including tenoners	615	3	148	464
Planers and molders	440	1	102	337
Shapers	64		18	46
Tenoners and other surfacing machines	111	2	28	81
Sanding machines	98		8	90
Nailing machines	18		1	17
Presses	57	1	7	49
Other woodworking machines	228		29	199

[1] Basic data for table 8, p. 28.

[2] Tabulatable injuries are industrial injuries, both compensable and noncompensable, which result in death, permanent total or permanent partial disability, or the loss of at least 1 day or shift.

[3] Excludes brush- and broom-making machines and cork-working machines because they are not regarded as woodworking machines in this report.

Compiled from annual reports, Massachusetts Department of Industrial Accidents, Boston.

TABLE VI.—*Minimum age for employment on all or specified woodworking machines compared with minimum age for general employment by State as of Jan. 1, 1941* [1]

Machines	States with an 18-year minimum age for employment on specified woodworking machines in which the basic minimum age for general employment is 15 or 16 [2]		States with a 16-year minimum age for employment on specified woodworking machines or on any power-driven machinery				States with no minimum-age provision applying specifically to all or to specified woodworking machines but in which employment on such machines may be subject to the basic minimum age	
			In which the basic minimum age for general employment is 14 [3]		In which the basic minimum age for general employment is also 16 [4]			
	Number	States	Number	States	Number	States	Number	States
Circular saws	3	N. J., Pa., Mich.	20	Ala., Ariz., Ark., Calif., Colo., Del., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Mex., N. Dak., Okla., Tenn., Vt., Wyo.	8	Conn., Mass., N. Y., N. C., Ohio, R. I., Utah, Wis.	17	Idaho, Iowa, Kans., La., Maine, Miss., Mont., Nebr., Nev., N. H., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.
Band saws	3	N. J., Pa., Mich.	18	Ala., Ariz., Ark., Calif., Colo., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Dak., Okla., Tenn., Vt., Wyo.	8	Conn., Mass., N. Y., N. C., Ohio, R. I., Utah, Wis.	19	Del., Idaho, Iowa, Kans., La., Maine, Miss., Mont., Nebr., Nev., N. H., N. Mex., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.
Planers	3	N. J., Pa., Mich.	18	Ala., Ariz., Ark., Calif., Colo., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt., Wyo.	8	Conn., Mass., N. Y., N. C., Ohio, R. I., Utah, Wis.	19	Del., Idaho, Iowa, Kans., La., Maine, Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.
Wood shapers	3	N. J., Pa., Mich.	18	Ala., Ariz., Ark., Calif., Colo., Del., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt.	8	Conn., Mass., N. Y., N. C., Ohio, R. I., Utah, Wis.	19	Idaho, Iowa, Kans., La., Maine, Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va., Wyo.
Wood jointers	3	N. J., Pa., Mich.	19	Ala., Ariz., Ark., Calif., Colo., Del., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt., Wyo.	8	Conn., Mass., N. Y., N. C., Ohio, R. I., Utah, Wis.	18	Idaho, Iowa, Kans., La., Maine, Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.

* See footnotes at end of table.

TABLE VI.—*Minimum age for employment on all or specified woodworking machines compared with minimum age for general employment by State as of Jan. 1, 1941* [1]—Continued

Machines	States with an 18-year minimum age for employment on specified woodworking machines in which the basic minimum age for general employment is 15 or 16 [2]		States with a 16-year minimum age for employment on specified woodworking machines or on any power-driven machinery				States with no minimum-age provision applying specifically to all or to specified woodworking machines but in which employment on such machines may be subject to the basic minimum age	
			In which the basic minimum age for general employment is 14 [3]		In which the basic minimum age for general employment is also 16 [4]			
	Number	States	Number	States	Number	States	Number	States
Wood turning or boring machines.	3	N. J., Pa., Mich.	17	Ala., Ariz., Ark., Calif., Colo., Fla., Ga., Ill., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt., Wyo.	7	Conn., N. Y., N. C., Ohio, R. I., Utah, Wis.	21	Del., Idaho, Ind., Iowa, Kans., La., Maine, Mass., Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.
Wood polishing machines.	3	N. J., Pa., Mich.	19	Ala., Ariz., Ark., Calif., Colo., Del., Fla., Ga., Ill., Ind., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt., Wyo.	7	Conn., N. Y., N. C., Ohio, R. I., Utah, Wis.	19	Idaho, Iowa, Kans., La., Maine, Mass., Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.
Sandpaper machinery.	3	N. J., Pa., Mich.	17	Ala., Ariz., Ark., Calif., Colo., Fla., Ga., Ill., Ky., Md., Minn., Mo., N. Mex., N. Dak., Tenn., Vt., Wyo.	7	Conn., N. Y., N. C., Ohio, R. I., Utah, Wis.	21	Del., Idaho, Ind., Iowa, Kans., La., Maine, Mass., Miss., Mont., Nebr., Nev., N. H., Okla., Oreg., S. C., S. Dak., Tex., Va., Wash., W. Va.

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[1] In this table the States having minimum-age provisions applying to all woodworking machines or to all power-driven machinery are included opposite each of the specified woodworking machines, since the general coverage embraces the particular machine.

[2] The 18-year minimum age for employment on specified woodworking machines in Michigan and Pennsylvania applies to power-driven woodworking machinery only in woodworking shops (regulations issued under the child-labor law). (Michigan also has a 16-year minimum age for operation of planers.) In both New Jersey and Pennsylvania, bona fide apprentices between 16 and 18 years of age may be employed on woodworking machines provided such work is done under proper supervision.

[3] In California the basic minimum age for employment is 15 years; in Wyoming there is no minimum age for general employment.

[4] Connecticut is classified under this column as having a 16-year minimum age for employment on specified woodworking machines because it has a 16-year minimum for employment in manufacturing, mechanical, and mercantile industries, which would apparently cover substantially all employments in which woodworking machines are used.

Source: State laws as of Jan. 1, 1941, and regulations under State laws up to Jan. 1, 1939.

Appendix C.—Industries Affected by N. R. A. Code Restrictions on Employment of Minors

In the following industries N. R. A. code authorities barred minors under 18 years of age from employment in the occupations of operator of or off-bearer from power-driven woodworking machines because of their hazardous nature:

- American match industry.
- Band instrument manufacturing industry.
- Bedding manufacturing industry.
- Beverage dispensing equipment industry.
- Clay machinery industry.
- Coin-operated machine manufacturing industry.
- Commercial refrigerator manufacturing industry.
- Cordage and twine industry.[1]
- Counter type ice-cream freezer industry.
- Dowel pin industry.
- End grain strip wood block industry.
- Excelsior and excelsior products industry.
- Flag manufacturing industry.
- Floor machinery industry.
- Household ice refrigerator industry.
- Industrial oil burning equipment manufacturing industry.
- Ladder manufacturing industry.
- Manufacturing and wholesale surgical industry.[1]
- Marine auxiliary machinery industry.
- Metal hat die and wood hat block industry.
- Mopstick industry.
- Musical merchandise manufacturing industry.
- Petroleum equipment industry and trade.
- Piano manufacturing industry.
- Picture moulding and picture frame industry.
- Pipe organ industry.
- Plumbing fixtures industry.
- Porcelain breakfast furniture assembling industry.
- Print roller and print block manufacturing industry.
- Printing equipment industry and trade.
- Smoking pipe manufacturing industry.
- Toy and playthings industry.
- Trailer manufacturing industry.
- Trout farming industry in the eastern section.

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[1] Worded slightly differently.

Upholstery spring and accessories manufacturing industry.
Venetian blind industry.
Wood cased lead pencil manufacturing industry.
Wood plug industry.
Wood turning and shaping industries.
Wooden insulator pin and bracket manufacturing industry.

Source: Child Labor Control Under N. R. A., by Solomon Barkin, Work Materials No. 45, March 1936, p. 66. Division of Review, National Recovery Administration.

Appendix D.—Advisory Committee on the Employment of Minors in Hazardous Occupations, 1932

This committee, appointed by the Children's Bureau upon the recommendation of the 1930 White House Conference on Child Health and Protection, included safety engineers, compensation-insurance experts, specialists in labor-law administration, and industrial hygienists.

The affiliations of the members given below are as of that time.

Cyril Ainsworth, Assistant Secretary, American Standards Association.
Emma M. Appel, M. D., Chief Medical Examiner, Vocational Guidance Bureau, Chicago Board of Education.
Clara M. Beyer, Director, Industrial Division, United States Children's Bureau.
David S. Beyer, Vice President and Chief Engineer, Liberty Mutual Insurance Co.
Courtenay Dinwiddie, General Secretary, National Child Labor Committee.
Martha M. Eliot, M. D., Specialist in Maternal and Infant Hygiene, United States Children's Bureau.
Wesley M. Graff, Director, Safety Engineering Division, National Bureau of Casualty and Surety Underwriters.
Alice Hamilton, M. D., School of Public Health, Harvard University.
Emery R. Hayhurst, M. D., Consulting Hygienist.
J. P. Leake, M. D., Senior Surgeon, in Charge of Office of Industrial Hygiene, United States Public Health Service.
Beatrice McConnell, Director, Bureau of Women and Children, Pennsylvania Department of Labor and Industry.
O. F. McShane, Industrial Commission of Utah.
Ellen Nathalie Matthews, Chairman, Child Labor Committee of the White House Conference on Child Health and Protection.
John P. Meade, Director, Division of Industrial Safety, Massachusetts Department of Labor and Industries.
Frieda S. Miller, Director, Division of Women in Industry, New York State Department of Labor.
Walter S. Paine, Manager, Engineering and Inspection Division, Aetna Life Insurance Co.
Charles F. Sharkey, Chief, Law Division, United States Bureau of Labor Statistics.
Maud Swett, Field Director, Woman and Child Labor Department, Wisconsin Industrial Commission.
Max Trumper, Ph. D., Industrial Toxicologist.

Appendix E—Hazardous-Occupations Order No. 5

June 24, 1941.

Occupations Particularly Hazardous for the Employment of Minors Between 16 and 18 Years of Age or Detrimental to Their Health or Well-Being

By virtue of and pursuant to the authority conferred by section 3 (l) of the Fair Labor Standards Act of 1938[1] and pursuant to the regulation prescribing the procedure governing determinations of hazardous occupations;[2] an investigation having been conducted with respect to the hazards for minors between 16 and 18 years of age in employment in occupations involved in the operation of power-driven woodworking machines; and a report of the investigation having been submitted to the Chief of the Children's Bureau; a finding and order relating to the employment of minors between 16 and 18 years of age in the said occupations having been proposed for final adoption by the Chief of the Children's Bureau upon the basis of the said report of investigation; a public hearing having been held with respect to the said proposed finding and order; all statements submitted in connection with the said hearing having been carefully considered; no such statement disclosing a just cause for substantial revision in the proposed finding and order and no substantial change having been made in the proposed finding and order; and sufficient reason appearing therefor,

Now, therefore, I, Katharine F. Lenroot, Chief of the Children's Bureau of the United States Department of Labor, hereby find and declare that:

Sec. 422.5. *Occupations involved in the operation of power-driven woodworking machines.* (a) *Finding and Declaration of Fact.*—The following occupations involved in the operation of power-driven woodworking machines are particularly hazardous for minors between 16 and 18 years of age:

1. The occupation of operating power-driven woodworking machines, including the feeding of material into such machines, of helping the operator to feed material into such machines, or of having direct control or supervision over the operation of such machines.
2. The occupations of setting up, adjusting, repairing, oiling, or cleaning power-driven woodworking machines.
3. The occupation of off-bearing from circular saws and from guillotine-action veneer clippers.

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[1] Act of June 25, 1938, ch. 676, 52 Stat. 1060, U. S. Code, titile 29, sec. 201.

[2] Issued November 3, 1938, pursuant to authority conferred by sec. 3 (l) of the Fair Labor Standards Act of 1938, and published in the Federal Register, vol. 3, p. 2640, November 5, 1938, Procedure Governing Determinations of Hazardous Occupations.

(b) *Definitions.* As used in this order—

1. The term "power-driven woodworking machines" shall mean all fixed or portable machines or tools driven by power and intended for cutting, shaping, forming, surfacing, nailing, stapling, wire stitching, fastening, or otherwise assembling, pressing, or printing wood or veneer.

2. The term "off-bearing" shall mean the removal of material or refuse directly from a saw table or from the point of operation. Operations not considered as off-bearing within the intent of this order include (a) the removal of material or refuse from a circular saw or guillotine-action veneer clipper where the material or refuse has been conveyed away from the saw table or point of operation by some mechanical means or by a gravity chute, and (b) the following operations when these do not involve the removal of material or refuse directly from a saw table or from the point of operation: the carrying, moving, or transporting of materials from one machine to another or from one part of a plant to another; the piling, stacking, or arranging of materials for feeding into a machine by another person; and the sorting, tying, bundling, or loading of materials.

This order shall not justify noncompliance with any Federal or State law or municipal ordinance establishing a higher standard than the standard established herein.

This order shall become effective on August 1, 1941, and shall be in force and effect until amended or repealed by order hereafter made and published by the Chief of the Children's Bureau.

KATHARINE F. LENROOT,
Chief of the Children's Bureau.

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